THE ANT LARVAE OF THE SUBFAMILY FORMICINAE[1]

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The Formicinae are generally regarded as the most highly specialized subfamily of ants, surpassing even the Dolichoderinae, which are close competitors. Their larvae, however, range from generalized to highly specialized—from the Melophorini to the Oecophyllini and Camponotini. By contrast the larvae of the Dolichoderinae constitute a homogeneous group and are all highly specialized by reduction.

In this article we describe the larvae of 64 species representing 18 of the 45 genera and 10 of the 12 tribes. All known references in the literature are cited bringing the total considered up to 117 species representing 23 genera.

Subfamily **Formicinae** Lepeltier

Thorax and first abdominal somite forming a more or less distinct neck which is rather stout and curved ventrally; rest of abdomen stouter, straight and subellipsoidal; posterior end round. Anus terminal or subterminal. Leg vestiges usually distinguishable. Thirteen differentiated somites. Integumentary spinules restricted, minute and arranged in transverse rows. Body hairs moderately numerous to abundant, short, uniformly distributed; alveolus and articular membrane usually lacking. Body-hair shapes varied; a species usually has two or three types; the most common types are (1) branched (branches two to many), (2) denticulate and (3) simple. Head neither large nor small; broader than long. Antennae minute to moderate in size, each mounted on a low convexity and bearing three sensilla. Head hairs few to abundant; short to long; rarely denser or longer than body hairs; alveolus and articular membrane present. Head hairs varied; a species usually has one or two types; the most common shapes are (1) branched (generally two or three branches); (2) denticulate and (3) simple. Usually there are hairs between the antennae. Labrum small to moderate-sized; bilobed or subparabolic; broader than long; narrowed ventrally; anterior surface bearing sensilla and minute hairs; posterior surface with sensilla and minute spinules; these spinules arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally. Mandibles small to moderate-sized; ratio of head width to mandible length = 2.3–5.5 (average 3); ratio of mandible length to mandible width at base =1.2–1.7 (average 1.4). Moderately sclerotized; subtriangular in anterior view; wedge-shaped, with the edge medial or with the basal third somewhat thick and the rest thin and blade-like; apex forming a small blunt smooth tooth which is slightly curved medially; medial teeth absent or vestigial; anterior and posterior surfaces with longi-

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tudinal and/or oblique ridges, which occasionally may bear spinules. Maxillae usually swollen ventrolaterally; apex conical, conoidal or paraboloidal and directed medially; spinules generally restricted to the apex or the medial surface; palp small, typically a skewed peg with five sensilla; galea finger-like with two apical sensilla. Labium with anterior surface spinulose; palp typically a low knob bearing five sensilla; opening of sericteries wide and salient, with two projections. Hypopharynx densely spinulose, the spinules minute and in numerous subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle.

Alderz, 1886:—The form of the woolly hairs ("ullhåren") characterizes the "Camponotidae" (p. 51). "Camponotid larvae have comparatively larger heads than Myrmicid larvae and the anterior corner of the first segment's ventral side is in the former large and projecting" (p. 52). Internal anatomy: pp. 59–64. "Uncinate hairs are single-hooked. Larvae moderately active" (p. 277). (Translation from the Swedish by Professor Edith E. Larson.)

Athias-Henriot, 1947:—"Tous les Camponotinés ont une tête grande à pièces développées. Elles sont relativement très mobiles" (p. 251). "Les *Camponotinês* ont des larves mobiles, à tête bien différenciée, à pièces buccales bien développées" (p. 253). Internal anatomy: pp. 258, 261 and 263 and Fig. 2 on p. 255. "Formicinés.—Les larves sont très primitives, avec un type anatomique très uniforme. Sous-famille très homogène. On peut toutefois classer les genres dans l'ordre suivant: 1. *Acantholepis*, 2. *Plagiolepis* et *Camponotus*, 3. *Categlyphis*, ce qui correspond à l'ordre suivi habituellement pour les adultes" (p. 268).

Bischoff, 1927, p. 384:—The larvae are fed with liquid food from the crops of the nurses.

Brun, 1924, p. 95:—"Die Fütterung wird . . . gewöhnlich in der Weise vorgenommen, dass die fütternde Arbeiterin einen Tropfen Nahrungsflüssigkeit aus ihrem Kropfe ausbricht und denselben auf den Mund der Larve fallen lässt."

Emery, 1925, p. 6:—"La nidification des *Oecophylla*, de quelques espèces de *Camponotus* d'Amérique et de la plupart des *Polyrhachis*, faite au moyen de la soie produite par leurs larves, m'a surtout frappé. Il m'a semblé impossible d'expliquer ce fait si extraordinaire par une simple convergence d'instincts; il est beaucoup plus vraisemblable que *Oecophylla*, *Camponotus* et les genres dérivés de celui-ci (entre autres *Polyrhachis*), aient eu un ancêtre commun, dont ils ont hérité cet instinct. La plupart des *Camponotus* l'ont perdu, à mesure que se développait le polymorphisme si remarquable de ce genre et la nidification dans le bois ou dans la terre. De même, quelques *Polyrhachis* du sous-genre *Chariomyrma*, qui habitent sous les écorces ou sous les pierres."

Forel, 1921:—"Les larves, quoique souvent mobiles, sont presque toujours alimentées directement par dégorgement du contenu du jabot de l'ouvrière qui les nourrit" (p. 24). (=1928, Vol. I, p. 24: "The larvae, although often mobile, are nearly always directly fed by the regurgitation of the contents of the nurses' crop.") "Les larves sont en général un peu plus mobiles que chez les *Dolichoderinae*"

(p. 140). (=1928, p. 234: "The larvae are generally a little more mobile than those of the Dolichoderinae.")

Forel, 1922:—"Les larves de quelques . . . *Camponotinae* sont nourries directment par leur ♀, qui leur dégorgent le contenu de leur jabot." (p. 136). (=1928, Vol. I, p. 517: "The larvae of some . . . Formicinae are directly fed by their ♀, which disgorge to them the contents of their crops.")

Gantes, 1949, p. 88:—"Chez les . . . Formicidés . . . nous voyons une évolution nette: . . . *Formica, Lasius, Cataglyphis* sont les plus primitifs: larve néonate nue ou presque, mandibule bien développée et très coupante, poils de la larve adulte très serrés. Larves agiles. *Plagiolepis, Camponotus,* sont plus évoluées: les larves sont moins agiles. Je ne les pas vues manger seules. Les mandibules sont plus massives. Les poils plus clairsemés. Chez les deux on trouve des poils en crosse chez les jeunes larves."

Kellogg, 1905, p. 541:—"The character and amount of the food given the larvae is carefully controlled by the workers."

Wheeler, 1900, p. 27:—"The worker ants can control the production of individuals like themselves and of individuals like their queen. It is further maintained that these differences are effected by the quantity and quality of the food administered to the larvae at a certain period of their development; but here our knowledge ends."

Wheeler, 1920, p. 48:—The trophorhinium may function as a stridulatory organ, "when the food supply is exhausted, and thus apprise the worker nurses of the larva's hunger." Many genera of Formicinae "also have elaborate but coarser stridulatory surfaces on the mandibles, so that the larva may be able to produce a variety of sounds and therefore apprise the nurses of more than one need or craving."

Wheeler, 1937, p. 38:—The larvae of the Formicinae are fed by a "careful administration *per os* of liquid food regurgitated from the nurse's crop."

KEY TO THE MATURE FORMICINE LARVAE IN OUR COLLECTION

1. Chiloscleres present . . . . . **TRIBE CAMPONOTINI**
   Without chiloscleres 2
2. Thorax noticeably more slender than the abdomen and forming a neck which is arched ventrally 3
   Not as above 10
3. Maxillary apex papillose . . . . . **TRIBE MELOPHORINI** 4
   Maxillary apex not papillose 5
4. Body hairs all denticulate . . . . . **Melophorus**
   Body hairs branched or with fuzzy tips . . . . . **Notoncus**
5. Hairs short simple spikes . . . . . **TRIBE GESOMYRMICINI**
   Hairs not as above 6
6. Head hairs numerous, denticulate, long, whip-like . . . **TRIBE GIGANTIOPINI**
   Head hairs not as above 7
7. Mandibles conspicuously broad; apical tooth abruptly marked off . . . . . **TRIBE FORMICINI** 8
   Mandibles not as above . . . . . **TRIBE PLAGIOLEPIDINI** 9
8. Body hairs with bifid tips (a few may have denticles on the branches) . . . . . **Formica**
   Body hairs of several types (simple, branched, denticulate) . . . . . **Lasius**

9. Body hairs of two types (smooth and denticulate); mandibles with a conspicuous jagged notch at the middle of the mesal border..... **Plagiolepis**
   Body hairs of three types (smooth, denticulate and branched); mesal border of mandibles with a few denticles..... **Acropyga**
10. Hairs simple, mostly minute.....11
    Branched hairs present.....12
11. All hairs minute, simple and acute..... **TRIBE OECOPHYLLINI**
    Most hairs minute; a band of long whip-like hairs on the dorsa of thoracic somites II and III and abdominal somites I–VI..... **TRIBE MYRMELACHISTINI**
12. Mandibles with a short apical tooth and a small subapical tooth..... **TRIBE PRENOLPIDINI** 13
    Mandibles with a long slender apical tooth; no subapical tooth..... **TRIBE BRACHYMYRMYICINI**
13. Body constricted near the middle; head hairs simple..... **Prenolepis**
    Body not constricted near the middle; head hairs branched..... **Paratrechina**

Tribe **Melophorini** Forel

Shaped somewhat like a crookneck squash (*i.e.*, thorax and first abdominal somite forming a moderately long and rather slender neck which strongly curves ventrally; rest of abdomen elongate, somewhat swollen and straight.) Anus subterminal. Cranium subhexagonal in anterior view. Head hairs few. Labrum bilobed. Maxillary apex papillose. Anterior surface of labium with a median protuberance near the base.

Genus **Melophorus** Lubbock

Shaped somewhat like a crookneck squash; thorax and first abdominal somite forming a moderately long and rather slender neck which is strongly curved ventrally; rest of abdomen elongate, somewhat swollen and straight, with the dorsal profile convex and the ventral nearly straight. Anus subterminal. Body hairs abundant and very short; of only one type: slender, slightly curved and with the basal half smooth, the distal half denticulate. Head small; cranium subhexagonal in anterior view. Antennae with two sensilla each. Head hairs few, moderately long and shaped like body hairs. Labrum bilobed: posterior surface with about seven sensilla. Maxillae large and lobose; apex papillose. Labium with a median protuberance on the anterior surface near the base.

Melophorus bagoti Lubbock

(Pl. I, figs. 1–5)

Shaped somewhat like a crookneck squash; thorax and first abdominal somite forming a moderately long and rather slender neck which is strongly curved ventrally; rest of abdomen elongate, somewhat swollen and straight, with the dorsal profile convex and the ventral nearly straight. Ventral surface somewhat flattened. Lateral longitudinal welts feebly developed. Slightly attenuated toward the posterior end which is round. Anus subterminal. Thirteen differentiated somites. Integument of anterior portion of prothorax spinulose, the spinules minute and in transverse rows. Body hairs abundant and uniformly distributed; basal half smooth, distal half denticulate; slender and slightly curved; slightly stouter on the ventral surface of the thorax; no alveolus or articular membrane; very short (length 0.1–0.25 mm.).

Head small; cranium broader than long, subhexagonal in anterior view. Head hairs few, slender, slightly curved; basal half smooth, distal half denticulate; moderately long (0.076–0.126 mm.); with alveolus and articular membrane. Antennae with two sensilla each. Labrum bilobed, due to a deep median incision of the ventral border; breadth twice the length; anterior surface with about eight sensilla near the ventral border and with four or five hairs on each lobe; posterior surface spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; about seven sensilla on the posterior surface. Mandibles robust and moderately sclerotized; width at base two-thirds the length; the basal three-fourths stout and wedge-shaped, the edge medial; narrowing to a slender apical tooth which is smooth, round-pointed and slightly curved medially and posteriorly; anterior and posterior surfaces roughened with numerous subparallel ridges which are mostly longitudinal. Maxillae large and lobose; the rounded apex furnished with numerous papillae; palp a skewed peg, with two apical, one subapical and two lateral sensilla; galea finger-like, with two apical sensilla. Labium with a median protuberance near the base of the anterior surface: the anterior surface spinulose, the spinules minute and isolated; palp a skewed peg with two apical and four lateral sensilla; opening of sericteries a small shelf in a shallow depression on the end of the labium. Hypopharynx densely spinulose, the spinules arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: 16 larvae from Central Australia.)

The larva of this species is unusually interesting for two reasons. First, it belongs to the most primitive genus of the Formicinae. Second, it resembles very closely the larvae of the lower Ponerinae; in fact, it might almost be placed in the genus *Ectatomma*.

Wheeler, G. C., 1938:—No wing rudiments (p. 141); vestigial gonopods of eighth and ninth abdominal somites present but those of the seventh apparently lacking (p. 142).

Genus **Notoncus** Emery

Shaped somewhat like a crookneck squash; thorax and first abdominal somite forming a moderately long and rather slender neck which is strongly curved ventrally; rest of abdomen elongate-subellipsoidal. Anus subterminal. Body hairs moderately numerous; of three types: (1) short, 4- to 6-branched, with the branches all in one plane and long hairs, (2) some branched, (3) some fuzzy-tipped, arranged in bands, one band around the middle of each somite. Antennae small. Head hairs few and short, with the tips fuzzy. Labrum bilobed; narrowed ventrally; posterior surface with 12 small and three large sensilla on each lobe. Maxillae small and narrow; apex papillose and directed subventrally; palp chair-shaped. Labium with a median spinulose protuberance on the anterior surface near the base.

Notoncus foreli Ern. André

(Pl. I, figs. 6–11)

Shaped somewhat like a crookneck squash; thorax and first abdominal somite forming a moderately long and rather slender neck,

which is curved ventrally; rest of abdomen elongate-subellipsoidal. Lateral longitudinal welts feebly developed. Leg vestiges present. Anus subterminal. Thirteen differentiated somites. Integument of the ventral surface of the thorax and abdominal somite I with short transverse rows of minute spinules. Body hairs moderately numerous and uniformly distributed; without alveolus and articular membrane. Of three types: (1) most hairs short (0.07–0.1 mm.), 4-to 6-branched, with the branches all in one plane; around the middle of each somite is a narrow band of about a dozen long (0.21–0.25 mm.) hairs, (2) some branched, (3) most with fuzzy tips. Cranium subhexagonal in anterior view; broader than long. Head hairs few, short (0.035–0.07 mm.); the tips fuzzy; alveolus and articular membrane present. Antennae small, mounted on low convexities; each with three (sometimes two) sensilla. Labrum bilobed due to a deep median incision of the ventral border; breadth 1.75 × length, narrowed ventrally; anterior surface of each lobe with four hairs and a few small sensilla; posterior surface densely spinulose, the spinules minute and arranged in rows which converge toward the dorsal corners; posterior surface of each lobe with 12 small and three large sensilla. Mandibles moderately sclerotized; width at base two-thirds the length; the basal three-fourths stout and wedge-shaped, with the edge medial; narrowing to a smooth, slightly curved apical tooth, which is variable in length and sharpness; a small blunt tooth on the mesal border at the base of the apical tooth; anterior and posterior surfaces roughened with numerous oblique subparallel ridges. Maxillae small and narrow; apex directed subventrally, conoidal, its integument papillose; palp chair-shaped, with two apical and three lateral sensilla; galea finger-shaped, with two apical sensilla. Labium with a median anterior prominence near the base, which is furnished with minute spinules arranged in short transverse rows; palp a short peg with two apical and two lateral sensilla; opening of sericteries a transverse slit on the anterior surface. Hypopharynx spinulose, the spinules exceedingly minute and arranged in long subtransverse rows. (Material studied: several larvae from Victoria, courtesy of Mr. W. L. Brown; and six damaged integuments of head and thorax from South Australia.)

Genus **Myrmecorhynchus** Ern. André

Myrmecorhynchus emeryi Ern. André

Wheeler, 1917, p. 17:—"*Young Larva.* Body plump, with distinct segments, constricted behind the prothoracic segment, which is large and swollen. Head rather small, broad, and rounded, covered with sparse, simple hairs, without antennae and with short maxillae and labium furnished with the usual truncated sense-papillae. Mandibles small, flattened, falcate, with long apical tooth and blunt denticles along the inner border. Surface of body covered with flexuous, 2-, 3-, or 4-branched hairs, except the ventral thoracic surface, which is beset with simple, bristly hairs. *Adult Larva.* Body much swollen, but with distinct segments. Head extremely small. Hairs almost lacking, except on the head and ventral surface of the anterior segments, where the hairs are short, simple, and bristly. The shape of the larva suggests that it does not spin a cocoon but forms a naked pupa." Pl. I, fig. 4:

a, young larva in side view; *b* and *c*, branched hairs of same; *d*, adult larva; *e*, head of same in anterior view; *f*, mandible of same.

Tribe **Plagiolepidini** Forel

Genus **Plagiolepis** Mayr

Thorax forming a short stout neck which is strongly arched ventrally; abdomen elongate, rather slender, straight and subcylindrical. Anus ventral. Body hairs short to rather long, the shorter denticulate, the longer whip-like. Cranium subheptagonal in anterior view. Head hairs few, moderately long and denticulate. Labrum small and not bilobed. Mandibles small; basal half broad; distal half forming a long, slender, round-pointed tooth; a conspicuous jagged notch at the middle of the mesal border. Maxillae rather narrow and short, with the apex paraboloidal and directed ventrally.

Gantes, 1949:—"*Plagiolepis*, *Camponotus* sont plus évoluées: les larves sont moins agiles. Je ne les pas vues manger seules. Les mandibules sont plus massives. Le poils plus clairsemés. Chez les deux on trouve des poils en crosse chez les jeunes larves" (p. 88). Les poils en crosse "chez la larve néonate sont répartis sur le dos et tout autour du bout de l'abdomen, puis aux stades suivants on ne les a plus que dorsalement et sur les derniers segments abdominaux. Chez la larve adulte il n'y en a plus (*Camponotus*), ou très peu (*Plagiolepis*)" (p. 87).

Plegiolepis (**Anoplolepis**) **longipes** (Jerdon)

(Pl. I, figs. 19–23)

Thorax forming a short stout neck, which is strongly arched ventrally. Abdomen elongate, rather slender, straight, subcylindrical; diameter greatest at the fifth abdominal somite, diminishing gradually toward the anterior end and more rapidly toward the posterior end, which is round-pointed. Lateral longitudinal welts feebly developed. Anus ventral. Thirteen differentiated somites. Body furnished with a uniform and moderately abundant covering of short to rather long hairs, some of which are denticulate, slightly curved and 0.05–0.12 mm. long, while others are simple, whiplike and longer (about 0.16 mm.); no alveolus or articular membrane. Cranium subheptagonal in anterior

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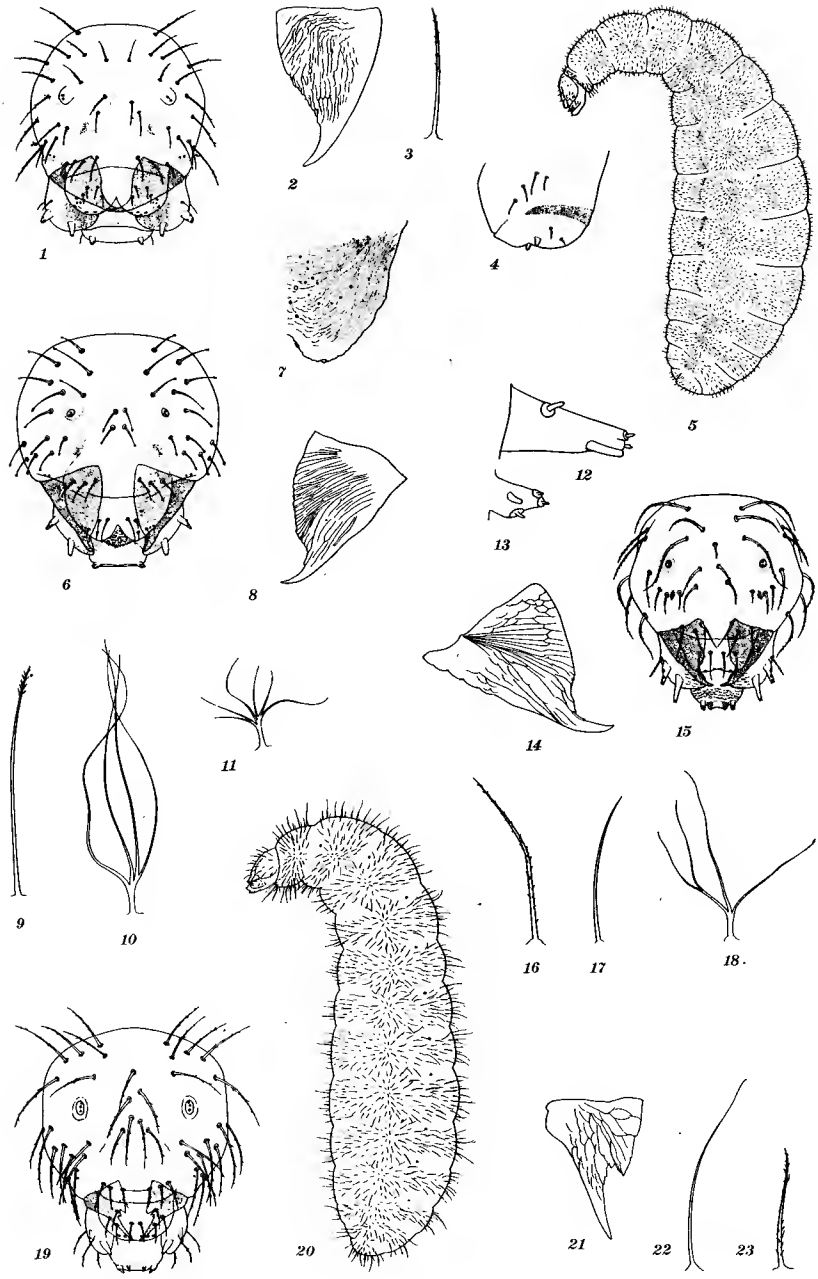
EXPLANATION OF PLATE I

Melophorus bagoti Lubbock, Figs. 1–5. 1, head in anterior view, ×44; 2, left mandible in anterior view, ×95; 3, body hair, ×113; 4, labium in side view, ×44; 5, larva in side view, ×4.

Notoncus foreli Ern. André, Figs. 6–11. 6, head in anterior view, ×57; 7, right half of labrum in posterior view, ×118; 8, left mandible in anterior view, ×95; 9 and 10, two long body hairs, ×121; 11, short body hair, ×121.

Acropyga moluccana papuana Mann, Figs. 12–18. 12, maxillary palp in anterior view, ×371; 13, labial palp in anterior view, ×371; 14, right mandible in anterior view, ×185; 15, head in anterior view, ×76; 16–18, three body hairs, ×95.

Plagiolepis (*Anoplolepis*) *longipes* (Jerdon), Figs. 19–23. 19, head in anterior view, ×95; 20, larva in side view, ×20; 21, right mandible in anterior view, ×185; 22 and 23, two body hairs, ×185.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view, about as broad as long. Head hairs few, long (0.07–0.1 mm.) and denticulate; with alveolus and articular membrane. Antennae with three sensilla each. Labrum small, breadth at base 1.5 × the length, ventral margin entire and convex, ventral corners broadly rounded; anterior surface with about eight hairs and with six sensilla near the ventral border; posterior surface spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; posterior surface with six sensilla near the middle. Mandibles small, moderately sclerotized; basal half broad; distal half forming a long, slender, smooth, round-pointed tooth; a conspicuous jagged notch at the middle of the mesal border; anterior and posterior surfaces roughened with longitudinal ridges. Maxillae rather narrow and short with the apex paraboloidal and directed ventrally; palp a skewed peg bearing two apical and three lateral sensilla; galea digitiform, bearing two apical sensilla. Labial palp a skewed peg bearing two apical and two lateral sensilla; opening of sericteries wide and saliant. Hypopharynx densely spinulose, the spinules arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: six larvae from the Philippine Islands.)

Emery (1899, p. 8) described the larvae of *longipes* as *squisitamente ortocefalo:* the head and mouth parts differed little from those he had observed in *Camponotus vitreus*. Pl. II, fig. 10*a*, larva in side view; *b*, head in side view, enlarged.

Goot, 1915 (we have translated from the Dutch original):—"The just hatched larva is elongate-oval, with the anterior end distinctly tapering and the posterior end broadly rounded. The head is very small, pointed and rather distinct. The body somites are marked off by shallow grooves. At this stage the larva is entirely naked and its color is glassy white. Its length is ±0.53 mm., its breadth ±0.21 mm. At first the larva develops slowly. As with the eggs, the young larvae are held together in packets, which are carried about by the workers. On such occasions apparently the workers also feed the larvae with small drops of liquid food which they regurgitate and press against the mouth of the larva. After about nine days, when the length has reached 0.96 mm. and the breadth 0.26 mm., the first (?) molt occurs, after which the outward appearance of the young larva is altered. The head and thorax are furnished with a rather large number of fine, moderately long hairs; the abdomen is still naked. The larvae are still in packets. . . . At the end of four days another molt occurs, . . . after which the abdomen is provided with numerous fine long hairs. The length is now 1.94 mm., the breadth 1.70 mm. . . . The larvae are no longer in packets but separate and in groups on the floor of the nest; there they are provided with food. Only when alarmed do the workers pick up and carry about the larvae of this size. During this last stage of its development the larva grows remarkably but still keeps its elongate bottle-like shape. About six days after the last molt it is fully grown. . . . Its length is now about 3.1 mm., its breadth 0.78 mm. It now loses what scant mobility is had previously and the color becomes more grayish and opaque. . . . It is carried by the workers to a place where it can find points of attachment for spinning

its cocoon. . . . In artificial nests this is preferably in the vicinity of a pile of pupae; if these are wanting, the workers cover the larva with bits of refuse, such as fine particles of earth, pieces of empty cocoons, fine threads, granular excrement, etc. This debris affords points of attachment for the first threads of the cocoon. The spinning of the cocoon is exclusively a larval function; by regular movements of the head the product of its spinning glands is fashioned into an opaque leathery cocoon, which is usually completed in one day. The last larval molt now occurs and the pupa emerges inside the cocoon" (pp. 4–5). The average life cycle is given (pp. 4–6) as: egg 19–20 days; larva 19 days; worker pupa in the rainy season 20–22 days (dry season 16–17 days); total two months. Table II (p. 10) shows the duration of the larval stage in 27 individuals.

Goot, 1916 (we have translated from the Dutch original):—"This queen larva may be distinguished from the worker larvae by its remarkable size: fully grown it is about 7 mm. long and 3 mm. broad. The body shape is that of the worker larva; the whole body is hairy but the hairs are relatively shorter. Pupation is similar to that of the worker larva" (p. 5). He referred (p. 5) to his 1915 study of the life cycle, which is given here as: egg 18–20 days, larva 16–20 days; pupa 20 days; total 50–65 days. Plate I is a photograph of eggs, larvae and cocoons.

Plagiolepis (Anoplolepis) custodiens (F. Smith)

Generally similar to *longipes*, except for larger body size and relatively smaller head. (Material studied: 10 queen larvae from the Congo.)

Plagiolepis (Plagiolepis) crozi Santschi

Athias-Henriot (1947, p. 251) states that the larva is very similar to that of *Camponotus barbaricus*. The head is less massive, the maxillae form much more distinct lobes. Dorsally the fourth, fifth and sixth somites bear crozier-shaped hairs. Fig. 1 on page 251 shows a larva in side view. Internal anatomy is discussed on pages 257, 260 and 266. On page 260 the larva is said to be omnivorous.

Gantes, 1949:—"Les larves ont la même forme en très petit [que celles de *Lasius niger*]. La tête diffère légèrement: le labre est formé d'un seul lobe qui recouvre entièrement les mandibules. Sur la face dorsale, on a trois poils sur chaque côté. Les mandibules se voient par transparence sous le labre. Elles sont très petites, simple triangle brun clair de 0 mm. 08, dont la base s'insère dans la tête. Tout le corps est couvert de poils simples, très fins et très courts" (p. 77). On Plate II are shown labrum, hairs and mandible of this larva. "En général, les larves adultes sont de taille inférieure ou égale aux ouvrières. Rarement, elles sont plus grandes comme chez *Plagiolepis crosi*" (p. 87). Growth is discussed on pp. 85 and 86. See also under the following species.

Plagiolepis (Plagiolepis) pygmaea (Latreille)

Gantes (1949):—"Chez *Plagiolepis pygmaea* on retrouve les mêmes sortes de poils que chez *Lasius*, mais en beaucoup plus petit; poils épineux, poils bifurqués uniquement dans la région anale et des poils

en crosse sur les segments 4 et 5 dorsalement. Enfin dan ce genre, j'ai une larve de sexué ♀ qui est plus grosse. La tête est semblable à celle de l'ouvrière. Elle diffère surtout par les poils: sur les segments de l'abdomen, dorsalement, on trouve des poils à double crochet, fins et longs, 0 mm. 25; sur les côtés de l'abdomen nous avons de longs poils terminés par une fourche. Il est curieux de voir le *P. pygmaea*, espèce européenne très voisine du *P. crosi* nord-africain, muni d'une pilosité larvaire notablement plus variée" (pp. 77–78). "D'une façon générale, des espèces voisines d'un même genre peuvent avoir des larves bien distinctes (par exemple *Plagiolepis crosi* et *pygmaea*)" (p. 89).

Gösswald (1934/5, pp. 120 and 125) cited *pygmaea* as a host of a mermithid and inferred that the nematode larva might have been parasitic in the ant larva.

Genus **Acropyga** Roger

Body hairs abundant and short; of three types—(1) denticulate, (2) 2- to 6-branched and (3) simple. Cranium subhexagonal in anterior view. Antennae small; each with two sensilla. Head hairs few, long and stout, of two types: (1) smooth and (2) denticulate. Maxillae with the apex paraboloidal and directed medially; palp a slender subcone, with five sensilla, each of which bears a peg. Labial palp a short skewed peg, with five sensilla, each of which bears a peg.

Acropyga moluccana papuana Mann

(Pl. I, figs. 12–18)

Body hairs abundant and rather uniformly distributed; short (0.16–0.25 mm.); no alveolus or articular membrane. Of three types: (1) simple hairs; (2) denticulate hairs; (3) branched hairs, with three to six (mostly four) branches which have long flexible tips. Integument with scattered short transverse rows of minute spinules. Cranium slightly broader than long, subhexagonal in anterior view. Head hairs few, long (0.08–0.2 mm.) and stout; denticulate or smooth; alveolus and articular membrane present. Antennae small, each mounted on a lobose protuberance; with two sensilla. Labrum bilobed due to a slight impression of the ventral border; narrowed ventrally; twice as broad (at base) as long; anterior surface of each lobe with two short hairs and with two sensilla near the ventral border; posterior surface spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; three sensilla on each half of the posterior surface. Mandibles moderately sclerotized; basal three-fourths stout and subtriangular; distal fourth a long, smooth, sharp-pointed apical tooth, which is curved medially; surface of base roughened with numerous ridges which are mostly longitudinal. Maxillae slightly swollen ventrolaterally; the apex paraboloidal and directed medially; palp a slender subcone with two apical and three lateral sensilla, each of which bears a conspicuous peg; galea digitiform, with two apical sensilla. Anterior surface of the labium roughened with short transverse rows of minute spinules; palp a short skewed peg with two apical and three lateral sensilla; each bearing a conspicuous peg; opening of sericteries wide and salient, with two projections. Hypopharynx densely spinulose, the

spinules minute and arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: four damaged integuments from the Solomon Islands.)

Acropyga moluccana Mayr

Generally similar to *papuana*, but with three types of body hairs: (1) 2- to 4-branched, with 2-branched the most abundant type on the dorsum, 0.10–0.16 mm. long; (2) simple, long and flexuous, the most abundant type on the venter, 0.1–0.35 mm. long; (3) a few denticulate, 0.04–0.16 mm. long. (Material studied: a single immature larva from Java.)

Acropyga (Rhizomyrma) fuhrmanni Forel

Weber, 1944:—"The larvae are moderately slender and have numerous hairs, some of which are simple, some trifid and some flattened and finely divided apically; these are lacking at the sutures" (p. 97). Fig. 6 on Plate I shows a larva in side view and two hairs.

Acropyga (Rhizomyrma) paramaribensis Borgemeier

Bünzli, 1935:—"Die Larven sind reichlich behaart, etwas schwächer am Vorderende und an der Bauchseite. Die Haare erreichen eine Länge von .18 mm und lassen oft unregelmässige Verzweigungen erkennen; später brechen Teilstücke ab, wohl wegen des häufigen Transportes der Larven durch die Arbeiterinnen. Von den larvalen Mundwerkzeugen heben sich die hakenförmigen, kurzen, etwas pigmentierten. Mandibeln am deutlichsten ab" (p. 519). Fig. 32 on p. 517 shows a worker larva in side view and hairs.

Genus **Acantholepis** Mayr

Acantholepis frauenfeldi Mayr

Athias-Henriot (1947) discusses internal anatomy on pages 254, 256, 260, 263, 265 (Fig. 5) and 266. The larvae are carnivorous(p.260).

Bernard (1948, p. 107):—"Larves couvertes de poils courts, droits; loin de s'accrocher au sable, elles roulent sur lui quand on ouvre le terrier." Internal anatomy and its relation to economy of water is discussed.

Tribe **Myrmelachistini** Forel

Genus **Myrmelachista** Roger

Straight and subcylindrical, diameter nearly uniform back to the fifth abdominal somite, then tapering rather rapidly to the posterior end, which is round-pointed; anterior end broadly rounded; no neck; head applied to the anteroventral surface. Anus terminal. Segmentation indistinct. Body hairs of two types: (1) minute spikes, which are generally distributed; (2) long whip-like hairs in transverse rows on the dorsal surface of mesothorax, metathorax and abdominal somites I-VI (one row each). Cranium subheptagonal in anterior view. Antennae with two sensilla each. Head hairs few, simple and minute. Labrum bilobed. Mandibles small and feebly sclerotized; base very broad; distal fourth forming a slender straight sharp-pointed tooth.

Maxillae rather small; palp a low discoid, with five sensilla, three of which bear each a slender peg; galea a low knob bearing two sensilla. Labium small.

The larvae of this genus certainly do not fit in the Formicinae, but resemble more closely the larvae of the Dolichoderinae, notably *Azteca*.

Myrmelachista (Decamera) zeledoni Emery

(Pl. II, figs. 1–6)

Straight and subcylindrical, rather stout, diameter nearly uniform back to the fifth abdominal somite, then tapering rather rapidly to the posterior end, which is round-pointed; anterior end broadly rounded; no neck; head applied to the anteroventral surface. Anus terminal. Leg vestiges present. Segmentation indistinct. Body hairs few; large intersomitic areas naked on the dorsal surface and also on the ventral surface of the thorax; no alveolus or articular membrane. Of two types: (1) minute spikes (0.009–0.027 mm.), which are uniformly distributed over the hairy areas of the body; and (2) long (about 0.13 mm.) whip-like hairs arranged in transverse rows on the dorsa of mesothorax, metathorax and abdominal somites I-VI (one row each). Cranium subheptagonal in anterior view with the corners broadly rounded; breadth 1.5 × the length. Hairs of head few, minute (0.009–0.012 mm. long), simple and slightly curved; arrangement and number variable; alveolus and articular membrane present. Each antenna mounted on a low convexity and bearing two sensilla. Labrum short; breadth three times the length; narrowed ventrally; bilobed due to a shallow impression of the ventral border; anterior surface with three or four hairs on each lobe; posterior surface densely spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; posterior surface with two clusters of three sensilla each near the middle. Mandibles small; feebly sclerotized; wedge-shaped, with the edge medial; subtriangular in anterior view; base very broad; distal fourth smooth, slender, straight and sharp-pointed; medial half of anterior and posterior surfaces roughened with numerous longitudinal ridges. Maxillae rather small; palp a low discoidal projection with five sensilla, three of which bear each a slender peg; galea a low knob with two apical sensilla, each of which bears a spinule. Labium small; palp a low knob with about five sensilla some of which bear each a spinule; opening of sericteries a short transverse slit on the anterior surface. Hypopharynx densely spinulose, the spinules arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: 11 larvae from Costa Rica.)

Myrmelachista (Myrmelachista) ambigua ramulorum Wheeler

Similar to *zeledoni* but differing in the following details: Body hairs about half as numerous. Breadth of labrum about twice the length; about five hairs on the anterior surface. (Material studied: eight damaged integuments from Culebra Island.)

Tribe **Brachymyrmicini** Emery

Genus **Brachymyrmex** Mayr

Stout and rather short; thorax curved ventrally to form an extremely short stout neck; abdomen straight; diameter greatest at the third abdominal somite, diminishing gradually toward either end. Posterior end narrowly rounded. Anus subterminal. Segmentation indistinct on the posterior half. Body hairs sparse and short; of three types: (1) mostly 3- to 5-branched, a few longer whip-like hairs on the dorsal surface of the abdomen which are either (2) simple or (3) bifid. Head moderately large; cranium transversely subelliptical in anterior view. Head hairs few and short; 2- to 5-branched. Labrum bilobed. Mandibles with the distal fourth long, slender, sharp-pointed and bent medially; mesal border erose. Galea a frustum, not finger-like.

The larvae of this genus have a dolichoderine habitus, resembling especially the larvae of *Dorymyrmex*.

Brachymyrmex depilis Emery

(Pl. II, figs. 10–15)

Stout and rather short; thorax curved ventrally to form an extremely short, stout neck; abdomen straight; posterior end narrowly rounded; diameter greatest at the third abdominal somite, diminishing gradually toward either end. Anus subterminal. Segmentation indistinct on the posterior half. Body hairs sparse and short; mostly 3- to 5-branched and 0.035–0.054 mm. long; on the dorsum of the abdomen a few are longer (about 0.07 mm.), whip-like and either simple or two-branched; no alveolus or articular membrane. Head moderately large; cranium transversely subelliptical; a fourth broader than long; gula with short transverse rows of spinules. Head hairs few, short (about 0.045 mm.), 2- to 5-branched; with alveolus and articular membrane. Each antenna with three sensilla. Labrum twice as broad as long, narrowed ventrally; bilobed due to a median impression of the ventral border; anterior surface with four small simple slender hairs and with four sensilla near the ventral border; posterior surface spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; about three large and three minute sensilla on the posterior surface of each lobe. Mandibles moderately sclerotized; wedge-shaped, with the edge medial; distal fourth bent medially to form a long slender, smooth, sharp-pointed apical tooth; basal three-fourths broadly subtriangular, with the mesal border erose and with anterior and posterior surfaces roughened with longitudinal and oblique ridges. Maxillae lobose; a few short longitudinal rows of spinules near the galea; palp a short frustum bearing two apical, two subapical and one lateral sensilla; galea a longer frustum, bearing two apical sensilla. Anterior surface of labium with a transverse band of spinules which are isolated or in short rows; palp a small frustum bearing two apical and two lateral sensilla; opening of sericteries a short transverse shelf projecting from the anterior surface. Hypopharynx spinulose, the spinules minute and arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: three larvae and 11 semipupae from New Jersey.)

Tribe **Gesomyrmicini** Wheeler

Genus **Gesomyrmex** Mayr

Thorax and first abdominal somite forming a short and very thick neck which is strongly arched ventrally; rest of abdomen somewhat swollen, straight and subcylindrical. Posterior end round. Body hairs sparse, simple and exceedingly minute. Head rather small; cranium transversely subelliptical in anterior view; integument sparsely spinulose. Antennae very small; each with two sensilla. Head hairs moderately numerous, simple and very short. Labrum small, feebly bilobed; posterior surface with six large sensilla near the center, around which are clustered 12 smaller sensilla. Mandibles heavily sclerotized; mesal border scalloped; distal fourth narrowed abruptly to form a slender, round-pointed apical tooth which is slightly curved medially. Maxillae with the apex round-pointed. Labial palp a low elevation bearing five sensilla.

Gesomyrmex kalshoveni Wheeler

(Pl. II, figs. 7–9)

Thorax and first abdominal somite forming a short and very thick neck which is strongly arched ventrally; rest of abdomen somewhat swollen, straight and subcylindrical. Lateral longitudinal welts feebly developed. Posterior end rounded. Leg, wing and gonopod vestiges present. Thirteen differentiated somites. Integument spinulose, the spinules minute and arranged in long transverse rows. Body uniformly and sparsely clothed with simple acuminate hairs, which are exceedingly minute (length 0.027–0.036 mm.); straight or slightly curved; alveolus and articular membrane present. Head rather small; cranium transversely subelliptical in anterior view, a third broader than long; integument sparsely spinulose, the spinules minute and in short transverse rows. Head hairs moderately numerous, simple, straight or slightly curved; acuminate; very short (length 0.027–0.036 mm.); alveolus and articular membrane present. Antennae very small; with two sensilla each. Labrum small; twice as broad (at base) as long; narrowed ventrally; bilobed due to a median incision of the ventral border; anteri-

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EXPLANATION OF PLATE II

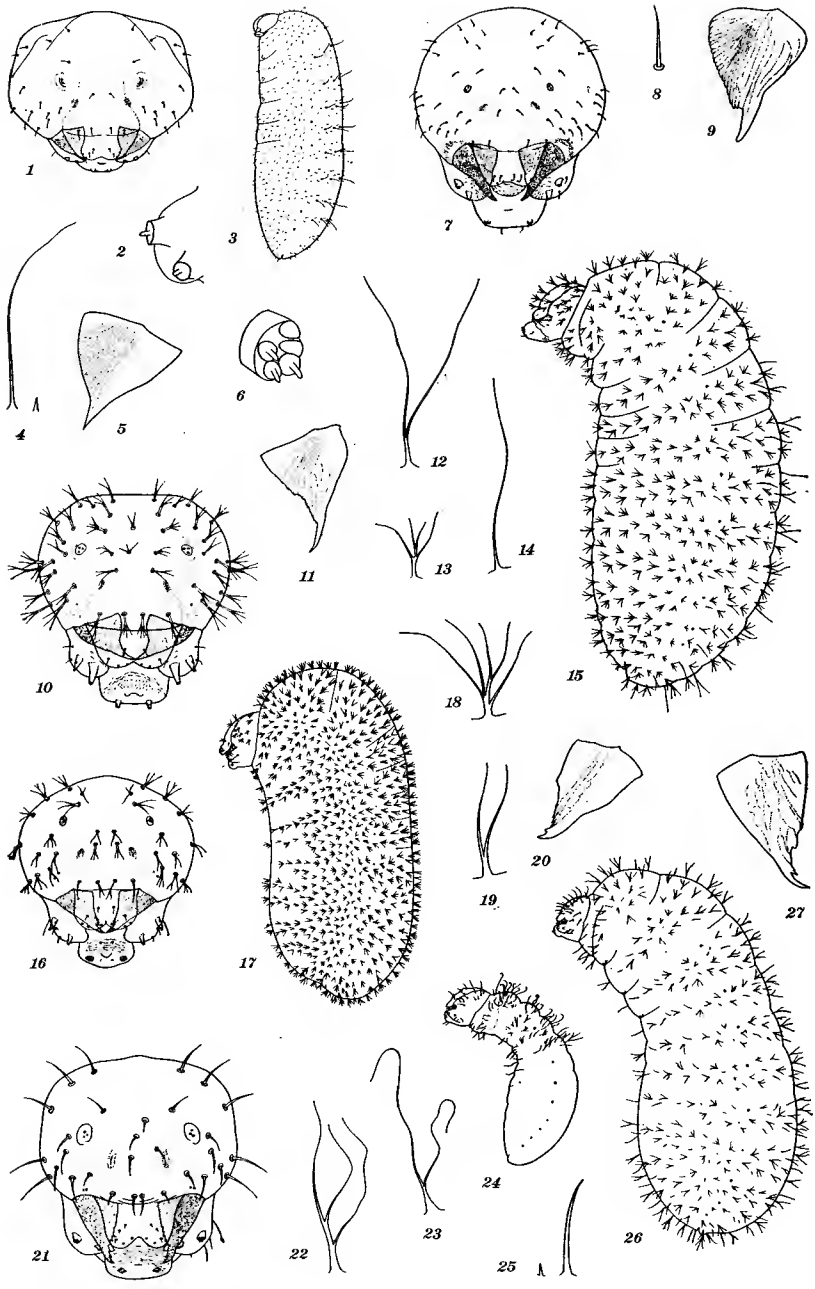
Myrmelachista (*Decamera*) *zeledoni* Emery, Figs. 1–6. 1, head in anterior view, ×67; 2, left antenna in anterior view, ×867; 3, larva in side view, ×16; 4, two body hairs, ×185; 5, left mandible in anterior view, ×185; 6, left maxillary palp in anterior view, ×867.

Gesomyrmex kalshoveni Wheeler, Figs. 7–9. 7, head in anterior view, ×57; 8, body, hair, ×235; 9, left mandible in anterior view, ×121.

Brachymyrmex depilis Emery, Figs. 10–15. 10, head in anterior view, ×121; 11, left mandible in anterior view, ×235; 12–14, three body hairs, ×235; 15, larva in side view, ×44.

Paratrechina (*Nylanderia*) *melanderi* Wheeler, Figs. 16–20. 16, head in anterior view, ×95; 17, larva in side view, ×28; 18 and 19, two body hairs, ×333; 20, left mandible in anterior view, ×185.

Prenolepis imparis (Say), Figs. 21–27. 21, head in anterior view, ×86; 22 and 23, two branched body hairs, ×185; 24, very young larva in side view, ×22; 25, two simple body hairs, ×185; 26, larva in side view, × 22.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or surface of each lobe with two hairs and (near the ventral border) three sensilla and with minute spinules which are isolated or in short rows; posterior surface sparsely spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally, posterior surface with about six large sensilla near the center, around which are 12 smaller sensilla. Mandibles heavily sclerotized; subtriangular in anterior view; wedge-shaped, with the edge medial; mesal border scalloped; distal fourth narrowed abruptly to form a smooth slender round-pointed apical tooth, which is slightly curved medially; basal three-fourths of anterior and posterior surfaces roughened with numerous longitudinal ridges. Maxillae with the apex paraboloidal, directed ventromedially and beset with spinules in short rows; palp a skewed peg, with one apical and 2 to 4 lateral sensilla; galea finger-like, with two apical sensilla. Labial palp a low elevation, bearing five sensilla; opening of sericteries a short transverse slit on the anterior surface of the labium. Hypopharynx with exceedingly minute spinules in rows which are grouped in two subtriangles whose bases are near the middle. (Material studied: two damaged integuments from Java.)

Wheeler, 1929*a*, p. 8:—The milk-white larvae "resemble those of other Formicinae in shape but are almost hairless. The head is very small and subglobular, the mandibles minute, with only an apical tooth which is drawn out into a slender, acute point. The semipupa measures a little over 7 mm. and is not enclosed in a cocoon."

Tribe **Prenolepidini** Forel

Plump and chunky; no neck; anterior end round. Segmentation indistinct. Head hairs few and short.

Genus **Prenolepis** Mayr

Plump and chunky; slightly curved ventrally; diameter nearly uniform but constricted at the first abdominal somite; ends rounded; not attenuated toward either end; head anteroventral; no neck. Anus terminal, with a small anterior and a conspicuous posterior lip. Thoracic somites feebly differentiated; abdominal somites indistinct. Body hairs sparse and short; of two types: (1) simple and (2) 2- to 3-branched. Cranium subheptagonal in anterior view. Head hairs few, short and simple. Mandibles with a slender short sharp-pointed medially curved apical tooth and one small subapical tooth; mesal border erose. Maxillae swollen ventrolaterally; apex narrowed to a conoid and directed medially; palp a small frustum; galea a frustum, not finger-shaped. Labial palp a small low knob.

The larvae of this genus have a distinctly dolichoderine habitus, resembling especially the larvae of *Dolichoderus*.

Prenolepis imparis (Say)

(Pl. II, figs. 21–27)

Plump and chunky; slightly curved ventrally; diameter nearly uniform but somewhat constricted at the first abdominal somite; ends rounded; not attenuated toward either end; prothorax with a low ventrolateral boss. Head anteroventral; no neck. Anus terminal with a

small anterior and a conspicuous posterior lip. Leg, wing and gonopod vestiges present. Thoracic somites feebly differentiated; abdominal somites indistinct. Posterodorsal surface of abdomen spinulose, the spinules minute and in short transverse rows. Body sparsely but uniformly furnished with short hairs of two types: (1) simple, 0.01–0.07 mm. long; (2) 2- to 3-branched, 0.04–0.09 mm. long, with the branches long and flexuous; no alveolus or articular membrane. Cranium subheptagonal in anterior view, a third broader than long; gula with short transverse rows of minute spinules. Hairs of head few, simple, slightly curved, short (0.05–0.07 mm.); with alveolus and articular membrane. Antennae with three sensilla each. Labrum bilobed due to a wide, deep incision of the ventral border; breadth (at base) nearly twice the length; narrowed ventrally; anterior surface of each lobe with three minute hairs and (near the ventral border) two sensilla; posterior surface densely spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; posterior surface with six sensilla near the middle. Mandibles moderately sclerotized; subtriangular in anterior view; wedge-shaped, with the edge medial; apical tooth smooth, short, slender, sharp-pointed and curved medially; one small, acute subapical tooth; mesal border erose; anterior and posterior surfaces roughened with a few longitudinal ridges. Maxillae swollen ventrolaterally; apex narrowed to a conoid and directed medially; palp a small frustum bearing four apical and one lateral sensilla; galea a small frustum bearing two apical sensilla. Labium with the anterior and lateral surfaces roughened with short transverse rows of minute spinules; palp a very small low knob bearing four sensilla. Opening of sericteries a short transverse slit on the anterior surface of the labium. Hypopharynx densely spinulose, spinules minute and arranged in numerous subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from Ohio, courtesy of Dr. Mary Talbot.)

The very young larva is less plump. It has the four anterior somites distinct, bent ventrally and furnished with hairs. The rest of the abdomen is a little stouter and its segmentation is indistinct; it is somewhat attenuated toward the posterior end, which is round-pointed. The anus is ventral. The posterior half of body is destitute of hairs but spinulose.

The queen larvae are very similar to worker larvae except that the body is much larger and the head relatively smaller. (Material studied: two specimens from Illinois.)

Talbot, 1943:—"All brood was matured at about the same rate. . . . Larvae reached their height of abundance during the latter part of July and diminished during early August" in Ohio (p. 32). The egg-larval development required about 31 days; the pupal period was of the same length (p. 44). It is inferred that the larvae are fed by the repletes (p. 32).

Genus **Paratrechina** Motschoulsky

Plump, chunky and turgid; subellipsoidal; anterior end broadly rounded, posterior end round-pointed; no neck. Anterior end formed

from the dorsa of prothorax and mesothorax. Head ventral near the anterior end. Anus posteroventral. Segmentation indistinct. Body hairs moderately numerous and very short; 2- to 5-branched, the branches long, slender and flexible. Head large; cranium transversely subelliptical. Antennae very small. Head hairs few, short, of two types: (1) simple and (2) 2- to 6-branched. Mandibles small; with a blunt apical tooth and one small subapical tooth; surface ridges few. Maxillae with the apex paraboloidal. Labial palp a low elevation.

The larvae of this genus are decidedly dolichoderine in body shape, resembling especially the mature larvae of *Tapinoma;* the mouth parts, however, are formicine.

Paratrechina (Nylanderia) melanderi Wheeler

(Pl. II, figs. 16–20)

Plump, chunky and turgid; subellipsoidal; anterior end broadly rounded, posterior end round-pointed; no neck. Anterior end formed from the dorsa of prothorax and mesothorax. Head ventral, near the anterior end. Anus posteroventral. Segmentation indistinct. Leg vestiges present. Hairs moderately numerous and uniformly distributed; very short (about 0.036 mm.); 2- to 5-branched, the branches long, slender and flexible; no alveolus or articular membrane. Head large; cranium transversely subelliptical in anterior view; breadth 1.5x length. Head hairs few, short (about 0.036 mm.); simple or 2- to 6-branched; alveolus and articular membrane present. Antennae very small, each with three sensilla. Labrum bilobed due to a median impression of the ventral border; breadth 1.5x length; lateral borders sinuate; anterior surface with four minute hairs and with three sensilla near the ventral border of each lobe; posterior surface spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; posterior surface with two groups of three sensilla each near the middle. Mandibles small; moderately sclerotized; subtriangular in anterior view; wedge-shaped, with the edge medial; with a small smooth apical tooth and one small subapical tooth, both blunt and directed medially; dorsal to these teeth the mesal border bears three to four acute denticles anterior and posterior surfaces with a few longitudinal ridges. Maxillae with the apex paraboloidal; palp a skewed peg bearing one subapical and three lateral sensilla; galea digitiform bearing two apical sensilla. Labium with a few transverse rows of minute spinules on the anterior surface; palp a low elevation bearing five sensilla; opening of sericteries a curved slit on the anterior surface of the labium. Hypopharynx spinulose, the spinules arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: 12 larvae from Oklahoma.)

The larvae of this genus are remarkable in that they differ greatly from other formicines but resemble very closely the larvae of the subfamily Dolichoderinae. The description, in fact, would almost fit the larva of *Dorymyrmex*. About the only non-dolichoderine character is the presence of branched hairs.

Paratrechina (Nylanderia) steinheili Forel

Eidmann, 1936, p. 99:—"Die Larven sind mit einem dichten und langen Pelz verzweigter Haare bedeckt."

Tribe **Formicini** Forel

Moderately stout; thorax and first abdominal somite forming a short stout neck which is curved ventrally; rest of abdomen straight; diameter greatest at the fourth abdominal somite, diminishing gradually toward either end. Body hairs short and moderately numerous. Mandibles robust; with the apical tooth sharply marked off from the rest, slender, smooth, round-pointed and slightly curved medially; mesal border denticulate near the base of the apical tooth. Maxillae swollen ventrolaterally; apex conoidal or paraboloidal and directed medially; opening of sericteries wide and salient, with two projections.

Genus **Pseudolasius** Emery

Pseudolasius myersi occipitalis Weber and Anderson

Weber and Anderson, 1950:—"Larva slender, hairs generally compound, mostly multifid, the longest in a 1.5-mm. larva about 0.03 mm. The larvae are white or slightly brownish with an easily observable dark intestinal mass about the level of the fifth to ninth segments. They are covered with bristly hairs which are best seen in the middle of the segments rather than in the trough of the segmental constrictions. These hairs, on examination under oil immersion, at a magnification of about 900 times, are seen to consist of a basilar scale or articulation socket and a branched stalk. The stalk divisions seem to be primarily of two types, one in which the stalk is thin and branches at the top only, the other in which the stalk is thicker and branches irregularly from shortly above the basal scale to the apex, the latter being divided into several branches" (p. 3). Figs. 8 and 9, hairs; fig. 16, larva in side view.

Genus **Lasius** Fabricius

Anus with anterior and posterior lips, the latter the larger. Five types of body hairs occur: (1) simple and slightly curved; (2) simple, long and whip-like; (3) denticulate; (4) 2- to 6-branched; (5) flat and many-branched, with the branches all in one plane. A larva is usually furnished with two or three of these types. Antennae small. Head hairs few and moderately long. Three types of head hairs occur: (1) simple, (2) denticulate and (3) 2- to 3-branched; a larva usually has two of these types. Mandibles subtriangular in anterior view; width (at base) about two-thirds the length; mesal border strongly convex and bearing a few denticles on the distal half; lateral border feebly convex.

Adlerz (1886) stated that the hairs of *Lasius* were similar to those of *Camponotus*, although of somewhat different form (p. 51). The body is flattened and its anterior third is strongly curved ventrally (p. 52). Brief reference to central nervous system (p. 58). "The larvae have branched, closely set hairs on the dorsal surface as well as the ventral.

The hairs are of the same type as those of *Camponotus* larvae, with sparse, long, fine-pointed branches or shorter and crowded branches. Woolly hairs . . . with fine, drawn-out tips, seldom with hook-like ends, as in *Camponotus*. In full-grown larvae I have found few bristles with lateral spines but on the other hand no woolly hairs or branched hairs" (p. 278; translated from the Swedish by Professor Edith E. Larson.)

Bischoff, 1927, p. 384:—The larvae of Lasius occasionally take solid food.

Donisthorpe, 1927*a*:—"The larvae practically occur in the nests throughout the year, being always present in the winter, and they take considerably longer to develop than is the case with the larvae of *Formica*. The workers feed the larvae with liquid food, but will also give them bits of dead insects, eggs, and other larvae, etc., to eat." (p. 207 = 1915, pp. 185–186). "Pale yellowish white, long, very narrow, and curved anteriorly, with the segments distinctly defined, and gradually increasing in breadth till just before the base. The whole body covered with short, slightly curved, yellow hairs of about equal length, which are more abundant in the younger larvae. The body appears to be finely striate transversely" (p. 210 = 1915, p. 187).

Donisthorpe, 1927*b*, p. 72:—Both adults and larvae of the staphylinid beetles, *Lamprinus* spp., devour eggs, larvae and pupae of *Lasius*.

Emery (1925, p. 227), referring to mermithogynes of *Lasius*: "Cette anomalie est due à un parasite du genre *Mermis*, qui se développe dans la larve et est contenu dans le gastre de l'imago."

Forel (1874) characterized the larvae of *Lasius* as "très mobiles" (p. 388 = 1920, p. 266) and stated that they grow very slowly (p. 389 = 1920, p. 267).

Gantes (1949, p. 88) asserted that the larvae of *Lasius*, *Formica*, and Cataglyphis are the most primitive of the Formicinae. "Larve néonate nue ou presque, mandibule bein développée et très coupante, poils de la larve adult très serrés. Larves agiles."

Gösswald (1934/5, p. 120) has given a general account of *Mermis* parasitism of this genus.

Janet, 1904, p. 33:—"Les jeunes larves de Lasius . . . sont couvertes d'un grand nombre de poils longs très fins et flexibles qui produisent un résultat analogue en s'enchevêtrant les uns dans les autres."

Wheeler, 1910, p. 405:—The clavigerid beetle *Claviger testaceus* often eats the larvae of *Lasius* spp.

Wheeler, 1928*a*, p. 202 (= 1926, p. 243):—The larvae may be given crude pieces of insects but the very youngest larvae (and possibly the older queen larvae) are fed regurgitated food.

Wheeler, 1933*a*, p. 10:—The colony-founding queen of *Lasius* may eat some of her own eggs, larvae and pupae.

The specific descriptions which follow are based upon material preserved in alcohol. The body shape of living larvae, especially when immature, may be somewhat different. The neck may be strongly curved (Pl. III, figs. 27 and 28) so that the head is directed posteriorly; the lateral longitudinal welts may be narrow, thick and conspicuous.

Also we suspect that the proportions and distribution of the several types of hairs will vary from instar to instar in the same individual. To verify this, however, would require a study in itself and we have not attempted it.

Subgenus **Lasius** Fabricius

Cranium suboctagonal in anterior view. Maxillae apparently without spinules; palp a skewed peg. Labial palp a frustum.

Lasius alienus americanus Emery

(Pl. III, figs. 1–8)

Moderately stout; thoracic and first abdominal somites forming a short stout neck which is slightly curved ventrally; rest of abdomen elongate-subellipsoidal; posterior end broadly rounded. Lateral longitudinal welts feebly developed. Anus terminal with anterior and posterior lips, the latter being the larger. Ten differentiated somites. Body hairs mostly short, moderately abundant and uniformly distributed, except on large intersegmental areas which are naked; without alveolus and articular membrane. Hairs of three types: (1) denticulate, 0.07–0.18 mm. long; (2) 2- to 3-branched (rarely 4), 0.05–0.07 mm.long; (3) long (about 0.13 mm.) and whip-like; branched hairs predominate (ratio 5:1) on dorsal and lateral surfaces. Cranium suboctagonal in anterior view; a third broader than long. Head hairs few, moderately long (0.05–0.07 mm.), denticulate or 2- to 3-branched; with alveolus and articular membrane. Antennae very small with two or three sensilla. Labrum bilobed due to a wide incision of the ventral border; slightly narrowed ventrally; breadth (at base) nearly twice the length; anterior surface of each lobe with three or four short hairs and about six sensilla on or near the ventral border; posterior surface densely spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; about 12 sensilla near the middle of the posterior surface. Mandibles robust and moderately sclerotized; wedge-shaped, with the edge medial; apical tooth sharply defined, slender, smooth, round-pointed and slightly curved medially and posteriorly; mesal border strongly convex and bearing a few denticles near the base of the apical tooth; lateral border feebly convex; anterior and posterior surfaces roughened by numerous longitudinal ridges. Maxillae swollen ventrolaterally; apex conoidal and directed medially; palp a skewed peg bearing one apical, two subapical and one lateral sensilla; galea a rather slender cone bearing two apical sensilla. Anterior surface of labium with a few minute spinules in short arcuate transverse rows; palp a frustrum bearing one apical, two subapical and two lateral sensilla; opening of sericteries a wide shelf on the anterior surface. Hypopharynx densely spinulose, the spinules arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from North Dakota.)

Sexual larvae are similar to worker larvae except that the body is larger and plumper while the head is relatively smaller; male larvae are intermediate between those of queens and workers.

The following notes were taken by the senior author while observing

living *americanus* larvae in 1920:—Five larvae are apparently sucking out the juices of a somewhat shriveled dead larva (same brood). The heads move rhythmically back and forth like pumps. One larva stops pumping, ejects a quantity of clear fluid from the mouth onto the carcass, rests with its mouth near the carcass and in the bubble of liquid, then sucks in the liquid and resumes pumping operations. The mandibles move from side to side during the pumping procedure. The mouth, or a part of it, is in the form of a short suckerlike proboscis which is worked back and forth in the pumping. Occasionally a larva stops, withdraws its head and licks its chops (apparently). When the carcass is lifted away with forceps the larvae adhere to it rather firmly.

Forbes, 1908:—"The workers feed their larvae almost constantly from the contents of their own stomachs, and often mouth and hover them, a mass of the ants clustering around and over them in a way to conceal them from view" (pp. 39–40). One of the figures on Plate I (p. 45) is an excellent wash drawing of a larva in side view (repeated: Sanderson, 1912, Fig. 123 on p. 168; Sanderson and Peairs, 1921, Fig. 130 on p. 154; Wellhouse, Fig. 155 on p. 343).

Tanquary, 1913:—The life cycle was reported as: egg 23–48 days, larva 16–39 days, pupa 20–40 days; averages 34, 26.4 and 27.1 respectively (pp. 425–434). "The length of the different stages varies with conditions. The larval stage may extend over more than a year. . . . During the winter, nests of this species contain only dealated females, workers, and larvae. . . . A small percentage of the pupae of this ant are naked, some of them owing to a failure of the larvae to attach their first silken threads. . . . The workers will eat some of the larvae, even though plenty of food is provided" (p. 441).

Wellhouse, 1926:—"The larvae are white, maggot-like creatures, curved at the smaller end, where a small but distinct head and a pair of jaws are located. The body bears a thin covering of hairs for protection" (p. 340). Fig. 155 on page 343, repeats Forbes (1908).

Lasius alienus (Förster)

Eidmann (1943, p. 236) found larvae in an overwintering colony.

Stärcke (1939, p. XIX and Figs. 1 and 2 on p. XX) has discussed internal anatomy of the antennae.

Wheeler (1928*a*, p. 205=1926, p. 248; and 1928*b*, p. 170) has discussed mermithogynes of this species; presumably the nematode larvae had parasitized the ants in the larval stage.

Lasius brunneus (Latreille)

Donisthorpe (1927*b*) discovered that a pselaphid beetle (*Batrisodes delaportei* Aub.) ate the brood of this ant (p. 45) and suspected that a staphylinid beetle (*Euryusa sinuata* Er.) did likewise (p. 72). He also reported that Silvestri found that another staphylinid (*Homoeusa acuminata* Kr.) devoured the larvae of this ant (p. 29).

Lasius niger (Linnaeus)

Adlerz (1886, p. 150) saw seven larvae of this ant arranged in a circle with their heads toward the center and their mouth buried in a

little ant larva. The larvae are often found sucking out smaller dead ants of other species.

Berlese (1909, Fig. 905 on p. 729) has illustrated a sagittal section of the pyloric region of the alimentary canal.

Donisthorpe, 1915, Pl. III = 1927*a*, Pl. III:—A photograph of a larva in side view.

Donisthorpe (1927*b*, p. 97) mentioned the probability that a mymarid wasp (*Litus cynipseus* Hal.) "had bred out from the eggs of the ants."

Eidmann, 1928*b*, p. 40:—"Die dichte Behaarung der überwinterten Larven kommt daher, dass der Körper der Larven durch die Entbehrungen der Überwinterung stark schrumpft und die Behaarung daher dichter erscheint als bei gut genährten Tieren."

Eidmann (1943, pp. 233–236) stated that the overwintering colony might or might not include larvae.

Gantes, 1949:—"La larve est beaucoup plus petite: 3 mm. Le corps est couvert de poils plus serrés, de plusieurs types: 1. *Poil simple*, long, fin, très souple, de 0 mm. 18. Se trouve surtout sur le bout de l'abdomen. 2. *Poil épineux* couvert d'épines sur la moitié supérieure, droit, mesurant 0 mm. 09; le tronc principal peut se diviser en deux branches secondaires également épineuses. On les trouve sur tout le corps, mais particulièrement sur le thorax. 3. *Poil épineux* beaucoup plus court et sur toute sa hauteur. 4. *Poil bifurqué* au tiers de sa hauteur. Il débute par un tronc large et épais qui se divise en deux branches devenant de plus en plus fines. Ils ont 0 mm. 10 de long. Les mandibules sont bien différenciées d'un brun très clair; elles ont la même forme que celles de *Formica:* elles mesurent 0 mm. 119" (p. 77). Fig. II on Pl. II: hair of mature larva, hair of young larva and mandible. "La jeune larve a simplement le corps couvert de poils longs et fins qui s'enchevêtrent les uns dans l'autre; ces poils se trouvent sur tout le corps, puis on les voit régresser sur le bout de l'abdomen pendant que les poils bifurqués définitifs apparaissent sur le corps" (p. 87). Growth is treated briefly on pages 85 and 86.

Goetsch (1937, p. 137) gave the life cycle of the *Gartenameise* (presumably *L. niger*) as: egg 13–30 days, larva 9–24 days, pupa 16–36 days.

Janet, 1897, pp. 10–11:—"Sur un petit Ver de terre . . . il y avait une vingtaine de larves qui paraissaient occupées à le sucer. Les larves restèrent quelque temps attachées à ce Ver que j'enlevai tout doucement, mais bientôt je les vis toutes, successivement, lâcher prise et retomber par terre."

Leeuwenhoek (1719, Figs. 5 and 6):—A larva in side view, probably *L. niger*.

Mayr, 1855, p. 283:—"Sie sind im Frühjahre oder im Beginne des Sommers in den Colonien anzutreffen, doch erzählt Gould, dass er auch Larven der *Formica nigra* und *Form. flava* im Winter am Grunde des Baues fand, und fügt noch die interessante Notiz hinzu, dass diese Larven viel dichter behaart waren, als jene, welche im Sommer gefunden werden."

Wheeler (1928*a*, p. 205 = 1926, p. 248) discussed mermithogynes of this species; presumably the nematode larvae had parasitized the ants in the larval stage.

Lasius niger neoniger Emery

"Dr. N. A. Cobb, our well-known authority on the nematodes, . . . writes me that he has found the larva of *Allomermis myrmecophila* Bayliss—'in the body cavity of a queen grub of . . . *neoniger*'" (Wheeler, 1930, p. 53). (See also Wheeler, 1928*a*, p. 205=1926, p. 248; and 1928*b*, p. 170.)

Lasius schiefferdeckeri Mayr

Wheeler (1914, p. 121) referred to a block of Baltic amber containing a larva of this extinct species.

Subgenus **Chthonolasius** Ruzsky

Cranium transversely subelliptical in anterior view. Anterior surface of labrum with denticulate hairs and with a median longitudinal furrow. Mesal surface of maxillae spinulose; palp a skewed thick-based peg. Labial palp a low knob.

Lasius (Chthonolasius) umbratus aphidicola (Walsh)

(Pl. III, figs. 9–16)

Moderately stout; thorax and first abdominal somite forming a short stout neck which is slightly curved ventrally; rest of abdomen elongate-subellipsoidal; lateral longitudinal welts broad and low. Posterior end rounded. Anus subterminal with anterior and posterior lips, the latter being the larger. Leg, wing and gonopod vestiges present. Thirteen differentiated somites. Body hairs mostly short, rather sparse and uniformly distributed, except on large intersegmental areas which are naked; without alveolus and articular membrane. Hairs of three types: (1) simple, slender, whip-like, 0.036–0.13 mm. long, the most abundant type; (2) stout, 0.06–0.12 mm. long and denticulate with numerous fine short branches; (3) 2- to 3-branched, 0.054–0.12 mm. long, the least abundant type. Cranium transversely subelliptical in anterior view; slightly broader than long; with a slight genal bulge. Head hairs few, rather short (0.05–0.07 mm.), denticulate, with alveolus and articular membrane. Antennae very small with three (sometimes two) sensilla. Labrum bilobed due to an incision of the ventral border; breadth (at base) nearly twice the length, slightly narrowed ventrally; anterior surface with a median longitudinal furrow, with two or three short denticulate hairs on each lobe and with two or three sensilla on or near the ventral border of each lobe. Posterior surface of labrum spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; about six large sensilla near the middle and about five small sensilla near the center of each lobe. Mandibles robust and moderately sclerotized; wedge-shaped, with the edge medial; apical tooth sharply defined, slender, smooth, round-pointed and slightly curved medially; mesal border strongly convex and bearing a few denticles on the distal half; lateral border feebly convex; anterior and posterior surfaces roughened with numerous longitudinal ridges. Maxillae slightly swollen ventrolaterally; apex paraboloidal and directed medially; mesal surface furnished with minute spinules arranged in numerous

short arcuate rows; palp a skewed peg with a stout base, bearing one apical, three subapical and one lateral sensilla; galea finger-like, with two apical sensilla. Anterior surface of labium with short curved mostly transverse rows of spinules of various lengths; palp a low knob bearing five sensilla: opening of sericteries wide and salient with two projections. Hypopharynx densely spinulose, the spinules minute and arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from North Dakota and Massachusetts.)

Observations on living larvae of various sizes:—They are capable of remarkable changes in shape. At one moment the body may be elongate and subcylindrical, with the neck slightly bent ventrally and with the segmentation indistinct. Upon stimulation it may change in a short time to a C-shaped creature with all segments distinct, with the venter depressed and, with the aid of the now conspicuous lateral longitudinal welts, forming a trough.

Park, 1932:—The clavigerid beetles *Adranes lecontei* Brendel embrace larvae of *aphidicola*, raking them with their tarsi, stroking them with their antennae, licking them and biting the surface. "The beetles, then, would appear to feed on the host larvae, at least in part, this food being composed of integumental exudates, oils, excretions, and possibly body fluid" (pp. 82–84). Fig. 2 on page 83 shows a beetle clasping an ant larva and licking its anterior somites. The pselaphid beetle *Ceophyllus monilis* Lec. was observed feeding on a dead ant larva (p. 87).

Park, 1947:—Clavigerid beetles of the genus *Adranes* occasionally scrape, puncture and suck eggs, larvae and pupae (p. 39). Fig. 5, p. 39 = Park, 1932, Fig. 2. The pselaphid beetle *Ceophyllus monilis* Lec. licks larvae and eats dead larvae (p. 40).

Lasius (Chthonolasius) umbratus meridionalis Bondroit

Wheeler (1928*a*, p. 205 = 1926, p. 248, and 1928*b*, p. 171) has discussed mermithogynes of this ant; presumably the nematode larvae had parasitized the ants in the larval stage.

Lasius (Chthonolasius) umbratus mixtus (Nylander)

Janet, 1897, p. 10:—"J'ai constaté, au moment de la capture . . . , qu'un certain nombre de grosses larves avaient, bien exactement devant la bouche, de petites masses molles qu'elles semblaient sucer. En examinant, à la loupe, quelques-unes de ces larves mises à part dans un nid artificiel, j'ai constaté des mouvements buccaux bien nets. Il est à peu près certain que ces larves aspiraient la partie liquide de ces petites masses molles dont quelques-unes étaient les restes de larves semblables à celles qui les suçaient." (Referred to by Wheeler, 1933*a*, p. 15.)

Lasius (Chthonolasius) flavus nearcticus Wheeler

Similar to *aphidicola* except in the following details:—Body hairs more numerous and of only two types: (1) 0.06–0.12 mm. long, with 2 to 6 long slender branches, the more abundant type; (2) 0.11–0.14 mm. long, simple, very few. Cranium a third broader than long; genal

bulge more prominent. Head hairs moderately numerous and longer; mostly simple, rarely branched or denticulate; labium with the spinules isolated and larger. (Material studied: eight larvae from New York.)

Lasius (Chthonolasius) flavus microps Wheeler

(Pl. III, figs. 17–21)

Similar to *nearcticus* except in the following characters:—Hairs of three types: (1) simple 0.04–0.11 mm. long; (2) 2- to 3-branched, 0.04–0.11 mm. long; (3) dendritic, flat, with stout base and numerous short slender branches which are all in the same plane, 0.04–0.06 mm. long. Head hairs shorter, of two types: (1) 2- to 3-branched; (2) denticulate. Apical tooth of mandible longer and more slender. (Material studied: numerous larvae from North Dakota.)

Lasius (Chthonolasius) flavus (Fabricius)

Adlerz (1886, pp. 52–53) discussed the apparent increase in hairiness of hibernating larvae. He stated (p. 52) that hairs of young larvae were approximately one-fifth of the body length.

De Geer, 1778, Pl. XIII, Fig. 26:—A larva in side view, probably *L. flavus*.

Donisthorpe (1927*b*) has seen the clavigerid beetle *Claviger testaceus* Preys. eat ant larvae (presumably *L. flavus*) (p. 14). The histerid beetle *Hetaerius ferrugineus* 01. "feeds on dead and wounded ants, and their larvae and pupae, mites, etc." (p. 51). "When examining a nest of *flavus* . . . I observed [a staphylined beetle, *Myrmedonia limbata* Pk.,] seizing one of the ant's larvae and dragging it out of the nest" (p. 67).

Eidmann (1943, pp. 236–243) concluded that *flavus* overwinters either with or without larvae.

Goetsch (1937, p. 137) gave for the life cycle: egg 22–52 days; larva 7–31 days, pupa 16–49 days.

Janet, 1897, p. 11:—"Dans un nid naturel de *Lasius flavus*, à un moment où les galeries superficielles étaient remplies de progéniture (13 août), j'ai vu deux groupes, de chacun cinq grosses larves, qui, légèrement recourbées sur elles-mêmes, et plus ou moins enchevêtrées les unes dans les autres, avaient, toutes les cinq dans chaque groupe, la bouche appliquée et comme collée sur une petite masse de substance molle et gluante. Dans un nid artificiel, de la même espèce, j'ai observé

EXPLANATION OF PLATE III

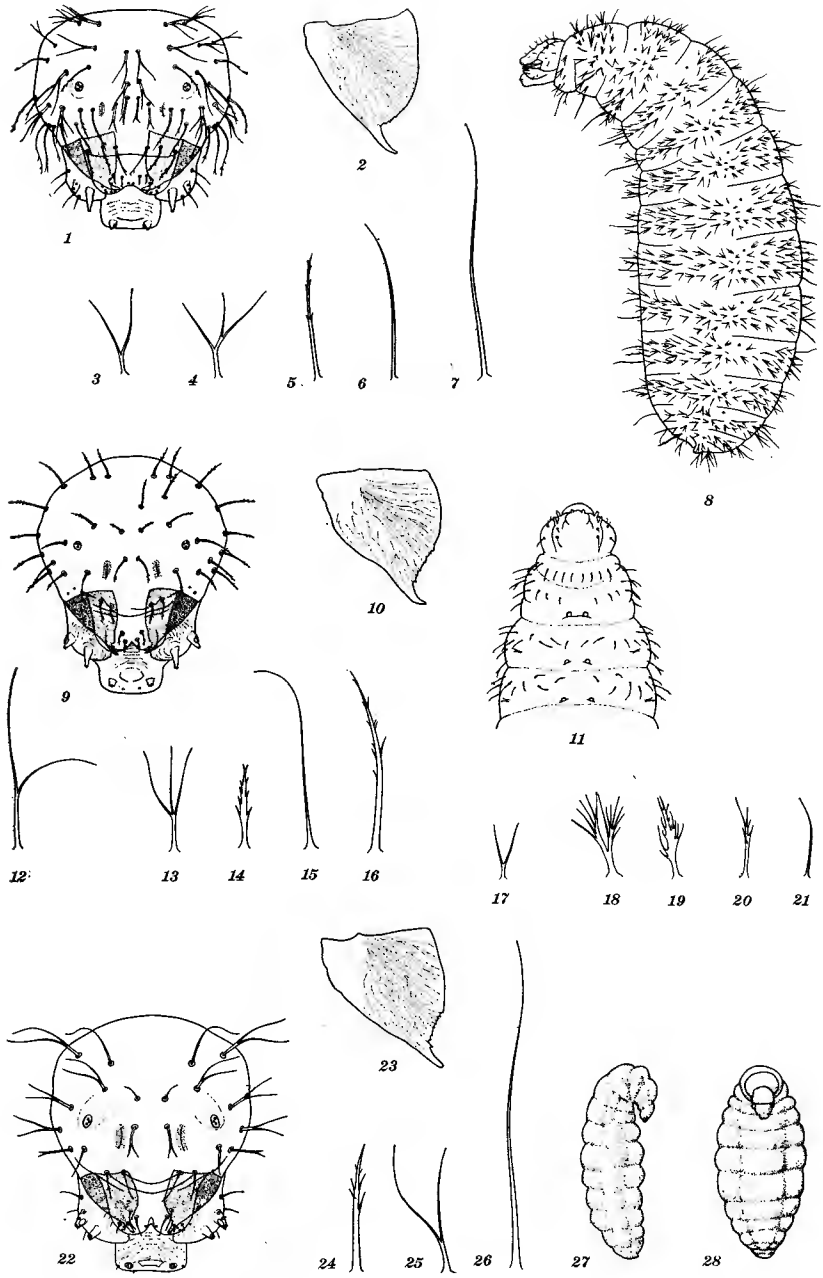
Lasius alienus americanus Emery, Figs. 1–8. 1, head in anterior view, ×86; 2, right mandible in anterior view, ×185; 3–7, five body hairs, ×185; 8, larva in side view, ×20.

Lasius (Chthonolasius) umbratus aphidicola (Walsh), Figs. 9–16. 9, head in anterior view, ×76; 10, right mandible in anterior view, ×185; 11, head and thorax in ventral view to show leg vestiges, ×28; 12–16, five body hairs, ×185.

Lasius (Chthonolasius) flavus microps Wheeler, Figs. 17–21, five body hairs, ×185.

Lasius (Acanthomyops) subglaber Emery, Figs. 22–26. 22, head in anterior view, ×86; 23, right mandible in anterior view, ×185; 24–26, three body hairs, ×185.

Lasius (Acanthomyops) claviger (Roger), Figs. 27 and 28. 27, ♀ larva in side view (hairs omitted), ×7; 28, ♀ larva in ventral view (hairs omitted), ×7.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(fig. 3) un groupe de trois grosses larves occupées à sucer une masse molle, allongée, qui s'est flétrie de plus en plus sous mes yeux. En examinant la cuticule chitineuse du résidu j'ai pu vérifier que la victime, qui avait servi de repas aux trois grosses larves, n'était autre qu' une de leurs semblables." (Referred to by Wheeler and Bailey, 1920, p. 251.)

Janet, 1904, p. 33:—"Dans un nid artificiel, des Lasius flavus avaient entassé des milliers de très jeunes larves au point de remplir, sur plusieurs centimètres de longueur, une vaste chambre de forme allongée. Ces petites larves étaient liaisonnées par leurs poils les unes avec les autres. Les Fourmis avaient pu, simplement en enlevant, après coup, un certain nombre de ces larves, creuser, dans cette masse vivante, de véritables galeries, de 2 millimètres de diamètre, juste suffisantes pour le passage d'une ouvrière."

Karawaiew, 1898, p. 402:—"Die junge milchweisse Larve von Lasius ist madenförmig, mit einem zugespitzten Vorderende und etwas gegen das Hinterende verdicktem Körper. Bei fixirten Larven ist das Hinterende ein wenig, das Vorder- resp. Kopfende stark gegen die Bauchseite gekrümmt, so dass die Form des Medianschnittes sehr der Klinge eines Gartenmessers gleicht. Der Kopfabschnitt ist vom ersten Brustsegmente ziemlich scharf durch eine Ringfalte abgegrenzt und trägt zwei Paar kurzer chitinbewaffneter Mundwerkzeuge (Mandibeln und Maxillen); von oben und von unten wird die Mundöffnung von je einer Lippe bedeckt. Die Zahl der Segmente, den Kopfabschnitt für ein einziges Segment gerechnet, ist 14, die Zahl der Abdominalsegmente also 10." Fig. 11 shows the sericteries in a profile outline of a larva (repeated: Wheeler, 1910, Fig. 124B on p. 222 and Karawaiew, 1906).

Karawaiew, 1900:—Internal metamorphosis.

Karawaiew, 1906, Fig. 11:—Profile of larva enclosing spinning glands. Referred to by Karawaiew, 1929, p. 252. Repeated by Wheeler, 1910, Fig. 124B on p. 222.

Lubbock, 1882, Pl. 5, fig. 3:—Larva in side view.

Mayr, 1855, p. 283:—See under *L. niger*.

Wheeler, 1910, p. 405:—The clavigerid beetle *Claviger testaceus* "is fed with regurgitated food, although it often eats the ant larvae."

Wheeler (1928*a*, p. 205=1926, p. 248; and 1928*b*, p. 170) has discussed mermithogynes of this species; presumably the nematode larvae had parasitized the ants in the larval stage.

Subgenus **Dendrolasius** Ruzsky

Lasius (Dendrolasius) fuliginosus (Latreille)

Adlerz (1886, p. 278):—"Woolhairs" are especially abundant in this species; the tips are usually finely attenuated, rarely hooked.

Eidmann (1943, pp. 228–233):—Larvae overwinter in the nest.

Subgenus **Acanthomyops** Mayr

Cranium subheptagonal in anterior view. Medial surface of maxillae spinulose; palp a skewed peg. Labial palp a low knob.

Wheeler & Bailey, 1920, p. 251:—The larvae of this subgenus have been observed to feed on whole insects or pieces of insects.

Lasius (Acanthomyops) subglaber Emery

(Pl. III, figs. 22–26)

Moderately stout; thoracic and first abdominal somites forming a short stout neck which is slightly curved ventrally, with the diameter decreasing anteriorly; rest of abdomen elongate-subellipsoidal. Posterior end rounded. Lateral longitudinal welts feebly developed. Anus terminal with anterior and posterior lips, the latter being the larger. Leg, wing and gonopod vestiges present. Body hairs mostly short, moderately numerous and uniformly distributed except on narrow intersegmental areas which are naked; without alveolus and articular membrane. Hairs of three types: (1) 2- to 3-branched, 0.05–0.1 mm. long; (2) denticulate, with stout base and several short branches, 0.05–0.11 mm. long; (3) a few simple flexuous hairs, 0.13–0.25 mm. long, longest on the ventral surface. Integument sparsely spinulose, spinules minute and in subtransverse rows. Cranium subheptagonal in anterior view, slightly broader than long, with a slight genal bulge. Head hairs few: moderately long (0.06–0.1 mm.); of two types, (1) simple and (2) 2- to 3-branched; with alveolus and articular membrane. Antennae small; each mounted on a low convexity and bearing three sensilla. Labrum bilobed due to a median incision of the ventral border; breadth (at base) nearly twice the length; slightly narrowed ventrally; anterior surface of each lobe with three or four short hairs and two or three sensilla; ventral border of each lobe with two sensilla; posterior surface densely spinulose, spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; six large and ten small sensilla on the posterior surface. Mandibles robust and moderately sclerotized; wedge-shaped, with the edge medial; subtriangular in anterior view; apical tooth sharply defined, slender, round-pointed, straight and directed medially; mesal border strongly convex and bearing a few denticles on the distal half; lateral border feebly convex; anterior and posterior surfaces roughened by numerous longitudinal ridges. Maxillae swollen ventrolaterally; apex paraboloidal and directed medially with a few minute spinules in short rows on the mesal surface; palp a skewed peg with two apical, two subapical and one lateral sensilla; galea digitiform with two apical sensilla. Labium with anterior surface sparsely spinose, the spinules minute and in short rows; palp a low knob bearing five sensilla; opening of sericteries a transverse shelf on the anterior surface of the labium. Hypopharynx densely spinulose, the spinules minute and arranged in subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from North Dakota.)

A half-grown larva resembles the mature larva, except that the body is more slender and more conspicuously segmented and the head hair are all denticulate.

Lasius (Acanthomyops) claviger (Roger)

(Pl. III, figs. 27 and 28)

Similar to *subglaber* but differing as follows: Body hairs all denticulate. Head hairs shorter and all denticulate. (Material studied: four damaged specimens from New York and one from New Hampshire.)

Immature larvae are more slender and more conspicuously segmented.

Wheeler, 1933*a*, p. 15:—"The larvae are fed on pieces of insects captured by the workers, instead of with regurgitated liquid food."

Lasius (Acanthomyops) interjectus Mayr

Similar to *subglaber* except in the following details: Body hairs somewhat shorter; denticulate the least numerous. Head hairs all denticulate. Maxillary palp a skewed peg with one apical, one subapical and three lateral sensilla. (Material studied: numerous larvae from North Dakota.)

Immature larvae are more slender and more conspicuously segmented.

Genus **Myrmecocystus** Wesmael

Myrmecocystus melliger Forel

McCook, 1882:—"When the grub is to be cleansed it is taken in the mouth, turned by the fore pair of legs, the antennae meanwhile touching and apparently aiding, while the mandibles are applied over the grub, their teeth apparently working chiefly within the annular divisions of the several joints. Doubtless this motion is accompanied by a free use of the tongue, but this I did not observe. When the grubs are to be fed, the workers pass from one to another, striding over them, and standing among them as they lie in little groups. The wee white things perk up their brownish yellow heads, which they stretch out and move around, evidently soliciting food. Their nurses move from one to another, apply the mouth for a moment, and pass on" (p. 46). Pl. VI, Fig. 34, shows workers feeding larvae.

Genus **Cataglyphis** Förster

Cataglyphis albicans Roger

Gantes, 1949:—"Cette espèce est remarquable par la grosseur de ses larves. Une jeune larve mesure 3 mm. et a une forme spéciale: en poire. L'abdomen est gonflé et la tête fine: le corps se rétrécit à partir des segments thoraciques qui sont les seuls distincts. La larve est nue sauf quelques rares poils sur la tête. Les mandibules sont des triangles dont la base s'insère dans la tête et l'apex se termine par une pointe fine. La larve au 5e stade mesure 8 mm. de long et 2 mm. de large; le corps est massif, un peu en forme de massue. Il est arqué vers le 3e anneau thoracique, de sorte que la tête est repliée ventralement: cette incurvation est plus accentuée que chez *Formica*. La forme générale, le nombre de segments sont identiques à *Formica*. La tête, fine et mobile, permet aux larves de se nourrir seules: je les ai vu plonger la tête dans un abdomen d'insecte. Tout le corps est couvert de poils simples, denses, rigides, qui sont nettement rangés en quinconce vers le bout de l'abdomen; à cet endroit, ils sont plus longs, 0 mm. 18, puis ils se raccourcissent en se rapprochant de la tête: sur le thorax 0 mm. 13 et sous la tête 0 mm. 028. La tête ressemble à celle de *Formica*. Les mandibules sont très grandes, 0 mm. 19, mais

la larve est beaucoup plus grosse. Elles ont à peu près la même forme, mais sont d'un brun foncé et les parties s'insérant dans la tête sont plus épaisses" (pp. 76–77). Pl. II, fig. 1, shows a young larva, body hairs and a mandible. "Les larves sont nues jusqu'au stade III" (p. 87). Growth is discussed on pages 85, 86 and 87. The larva is primitive: "larve néonate nue ou presque, mandibule bien développée et très coupante, poils de la larve adulte très serrés. Larves agiles" (p. 88).

Cataglyphis bicolor (Fabricius)

Athias-Henriot (1947):—Internal anatomy, pp. 260, 263, and 264. "Carnivore" (p. 260).

Cataglyphis viatica (Fabricius)

Bedel (1895) collected *Eucharis bedeli* Cameron with "*Myrmecocystus viaticus*" in Algeria. The ant might be either this species or *C. bicolor*. Presumably the eucharid larva was parasitoid on the ant larva. (Referred to by Ruschka, 1924, p. 87.)

Cataglyphis (Machaeromyrma) bombycina Roger

La larve "a une tête petite, le corps couvert d'une fine pubescence et de grand macrochètes simples clairsemés. La cuticle est chagrinée (mais ceci est peut-être dû à la préparation). En dehors de la pubescence, il n'y a pas d'adaptation particulière à la vie dans le sable chez cette Fourmi saharienne" (Athias-Henriot, 1947, p. 252).

Bernard, 1948, p. 107:—Les larves sont "couvertes de poils courts, droits: loin de s'accrocher au sable, elles roulent sur lui quand on ouvre le terrier."

Genus **Formica** Linnaeus

Prothorax with a pair of lateral swellings. Anus with a prominent posterior lip. Body hairs mostly with bifid tips. Antennae large and drumlin-shaped (=semiovoidal). Head hairs moderately numerous, short, mostly with bifid tips. Labrum small; anterior surface of each lobe with ventrolateral swelling. Mandibles roughly quadrangular in anterior view; breadth (at base) nearly equal the length; mesal border convex; lateral border obtusely angulate near the middle. Maxillae with the apex spinulose; palp a skewed peg. Labial palp a low knob.

Adlerz, 1886:—"Larvae not flattened, posterior part of body greatly expanded. Dorsal as well as ventral surface clothed with a few short bristly hairs" (p. 283; translated from the Swedish by Professor Edith E. Larson). Internal anatomy—pages 58–64.

Bischoff, 1927, p. 384:—The larvae of this genus occasionally take solid food.

Buchsbaum, 1948, p. 292–25:—Photograph of ant brood, probably that of *Formica* sp.

Clausen, 1940, p. 221:—*Eucharis* is most frequently associated with *Formica:* the eucharid larvae are parasitic on the mature larvae or pupae of the ants.

Donisthorpe, 1927*a*:—"Pale yellowish white, long, narrow, and curved anteriorly; head considerably narrower than the rest of the body;

segments well defined, transversely striate, and gradually increasing in width till just before the distal end. The whole body covered with short straight hairs of equal length, which appear to be bifid at the apex, and are more abundant on the younger larvae." (p. 284 = 1915, p. 243).

Donisthorpe, 1927*b*, p. 17:—Staphylinid beetles of the genus *Atemeles* eat the larvae of *Formica*.

Emery, 1899, p. 5:—The mandibles of ponerine larvae are much larger than those of the larvae of *Formica*.

Forel, 1874, p. 389 (=1920, p. 266):—Les larves "des *Formica* croissent vite."

Gantes, 1949:—"Les larves de *Formica* sont des larves assez primitives: tête mobile, à mandibules bien développées: ces larves se nourrissent seules; la tête est repliée sur le ventre, qui sert de table sur laquelle l' ♀ dépose la nourriture. Les jeunes larves sont à peu près nues" (p. 76). "Ont une très forte croissance aux stades IV et V, vingt fois plus intense. Ce type semble le cas des larves primitives: il se rapproche de celui des guêpes" (p. 85). "*Formica*, *Lasius*, *Cataglyphis* sont les plus primitifs: larve néonate nue ou presque, mandibule bien développée et très coupante, poils de la larve adulte très serrés. Larves agiles" (p. 88).

Herbert, 1934, p. 21:—Photograph of a larva, probably *Formica*.

Wheeler, 1910:—The larvae of the myrmecophilous staphylinids *Lomechusa*, *Atemeles* and *Xenodusa* feed on the larvae of *Formica*, pp. 406–7; also 1923*b*, p. 230 (=1923*a*, p. 30). The presence of *Lomechusa* within the *Formica* nest leads to the withholding of food from the ant larvae; the result is pseudogynes (p. 422). Wheeler also cited numerous papers by Wasmann on these beetles, which we have not consulted.

Subgenus **Proformica** Ruzsky

Cranium subrectangular in anterior view, slightly broader than long, with the corners rounded. Mandibles with the mesal border jagged near the base of the apical tooth.

Formica (Proformica) neogagates Emery

(Pl. IV, figs. 8–10)

Body stout; thorax and abdominal somite I strongly curved ventrally, rest of abdomen straight; diameter greatest at the fourth abdominal somite, diminishing gradually toward either end; posterior end narrowly rounded; lateral longitudinal welts feebly developed; prothorax with a pair of lateral swellings. Anus terminal, with a prominent posterior lip. Leg, wing and gonopod vestiges present. Thirteen differentiated somites. Body hairs moderately abundant; short (0.05–0.08 mm.); uniformly distributed; without alveolus and articular membrane. Hairs mostly with the tips bifid (rarely with the branches forked), very rarely with the tip unbranched. Integument spinulose, spinules minute and in transverse rows. Cranium subrectangular in anterior view, slightly broader than long with the corners rounded. Head hairs moderately numerous; short (0.05–0.08 mm.); mostly with bifid tips, a very few trifid or simple. Antennae large;

drumlin-shaped; with three sensilla each. Labrum small and short; breadth (at base) a little more than twice the length; narrowed ventrally; ventral corners rounded; bilobed due to a wide depression in the ventral border; anterior surface of each lobe with a ventrolateral swelling which bears two or three sensilla and two or three minute hairs; ventral border of each lobe with three sensilla; posterior surface spinulose, the spinules minute and arranged in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; posterior surface with about a dozen scattered sensilla. Mandibles rather small and moderately sclerotized; short and stout; breadth (at base) nearly equal to length; roughly quadrangular in anterior view; mesal border strongly convex; lateral border obtusely angulate near the middle; wedge-shaped, with the edge medial; apical tooth sharply defined, slender, smooth, tapering, round-pointed and slightly curved medially; mesal border jagged near the base of the apical tooth; anterior and posterior surfaces roughened with numerous sublongitudinal ridges. Maxillae swollen ventrolaterally; apex paraboloidal and directed medially; apex spinulose, the spinules minute and in short rows; palp a skewed peg, with one apical, two subapical and one lateral sensilla; galea finger-like, with two apical sensilla. Anterior and lateral surfaces of labium with short arcuate subtransverse rows of minute spinules; palp a low knob bearing four sensilla; opening of sericteries wide and salient, with two projections. Hypopharynx densely spinulose, the spinules minute and in numerous subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from North Dakota.)

Young larvae similar to mature larvae except as follows: head relatively larger; anus ventral; integumentary spinules more conspicuous posteriorly; hairs sparser.

Subgenus **Neoformica** Wheeler

Cranium subcircular in anterior view. Mandibles with the mesal border denticulate near the base of the apical tooth.

Formica (Neoformica) pallidefulva nitidiventris Emery

(Pl. IV, figs. 15–17)

Body stout; thorax and abdominal somite I curved ventrally, rest of abdomen straight; diameter greatest at the fourth abdominal somite, diminishing gradually toward either end; posterior end rounded; lateral longitudinal welts feebly developed; prothorax with lateral swellings. Anus terminal, with a prominent posterior lip. Leg, wing and gonopod vestiges present. Thirteen differentiated somites. Body hairs short (0.05–0.11 mm.), moderately abundant and uniformly distributed; mostly with bifid tips, rarely with the branches subdivided; without alveolus or articular membrane. Integument of ventral surface of thorax sparsely spinulose, the spinules minute and in short rows. Cranium subcircular in anterior view. Head hairs moderately numerous; short (0.054–0.072 mm.); bifid tips, rarely with the branches subdivided; alveolus and articular membrane present. Antennae mounted on low convexities; drumlin-shaped; each with three sensilla.

Labrum bilobed due to an incision of the ventral border; breadth (at base) nearly twice the length; not narrowed ventrally; ventral corners rounded; anterior surface of each lobe with four or five hairs and with eight sensilla on and near the ventral border; posterior surface spinulose, the spinules minute and in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; posterior surface with about eight scattered sensilla on each lobe. Mandibles moderately sclerotized, robust and roughly quadrangular in anterior view; breadth (at base) nearly equal to length; mesal border convex; lateral border obtusely angulate near the middle; wedge-shaped, with the edge medial; distal sixth forming a distinct, slender, smooth, round-pointed apical tooth; mesal border denticulate near the base of the tooth; anterior and posterior surface roughened with numerous sublongitudinal ridges. Maxillae swollen ventrolaterally, apex conoidal, directed medially; spinulose; palp a skewed peg bearing two apical, two subapical and one lateral sensilla; galea digitiform, bearing two apical sensilla. Labium with the anterior and lateral surfaces spinulose, the spinules minute and in short transverse rows; palp a short peg, bearing four apical and one lateral sensilla; opening of sericteries wide and salient with two conspicuous projections. Hypopharynx densely spinulose, the spinules minute and in numerous subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: ten larvae from New York.)

Subgenus **Formica** Linnaeus

Cranium subheptagonal in anterior view. Mandibles with the mesal border denticulate near the base of the apical tooth.

Formica altipetens Wheeler

(Pl. IV, figs. 1–5)

Body stout; thorax and abdominal somite I curved ventrally, rest of abdomen straight; diameter greatest at the fourth abdominal somite, diminishing gradually toward either end; posterior end rounded; lateral longitudinal welts feebly developed; prothorax with a pair of lateral

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EXPLANATION OF PLATE IV

Formica altipetens Wheeler, Figs. 1–5. 1, head in anterior view, ×57; 2, typical body hair, ×185; 3, two body hairs with denticulate branches, ×185; 4, right mandible in anterior view, ×138; 5, larva in side view, ×16.

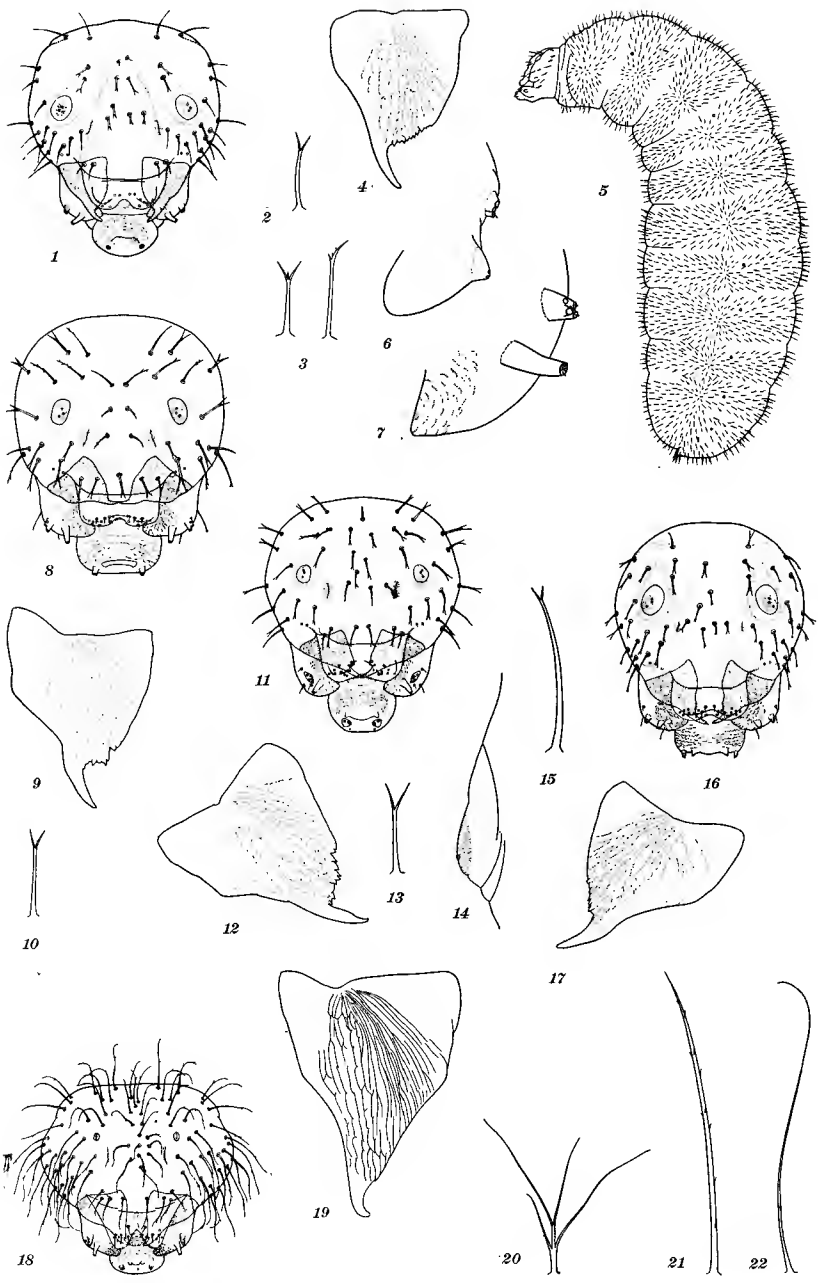
Formica neoclara Emery, Figs. 6 and 7. 6, left maxilla of very young larva in anterior view, ×235; 7, left maxilla of mature larva in anterior view, ×235.

Formica (*Proformica*) *neogagates* Emery, Figs. 8–10. 8, head in anterior view, ×67; 9, right mandible in anterior view, ×185; 10, body hair, ×185.

Formica (*Raptiformica*) *bradleyi* Wheeler, Figs. 11–14. 11, head in anterior view, ×58; 12, right mandible in anterior view, ×185; 13, body hair, ×185; 14, left antenna in side view, ×242.

Formica (*Neoformica*) *pallidefulva nitidiventris* Emery, Figs. 15–17. 15, body hair, ×235; 16, head in anterior view, ×56; 17, left mandible in anterior view, ×138.

Gigantiops destructor (Fabricius), Figs. 18–22. 18, head in anterior view, ×28; 19, right mandible in anterior view, ×95; 20–22, three body hairs, ×95.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swellings. Anus terminal, with a prominent posterior lip. Leg vestiges present. Ten differentiated somites. Body hairs moderately numerous and uniformly distributed; short (0.045–0.072 mm.); straight or slightly curved; the tips bifid with the branches frequently denticulate; without alveolus and articular membrane. Integument spinulose, the spinules minute and arranged in short transverse rows. Cranium subheptagonal in anterior view, slightly broader than long. Head hairs moderately numerous: short (0.036–0.072 mm.); simple or with the tips bifid; with alveolus and articular membrane. Antennae small, drumlin-shaped, mounted on a low convexity, each with three sensilla. Labrum small; bilobed due to a wide deep incision of the ventral border; breadth (at base) twice the length; narrowed ventrally; ventral corners rounded; anterior surface of each lobe with a ventrolateral swelling and with seven or eight sensilla and/or minute hairs; posterior surface spinulose, the spinules minute and in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; posterior surface with about 10 scattered sensilla on each lobe; ventral border with a few spinules. Mandibles moderately sclerotized; breadth (at base) four-fifths the length; roughly quadrangular in anterior view; mesal border strongly convex; lateral border obtusely angulate near the middle; wedge-shaped, with the edge medial; apical tooth smooth, long, slender, round-pointed and slightly curved medially, mesal border denticulate near the base of the apical tooth; anterior and posterior surfaces roughened with rather numerous longitudinal ridges. Maxillae rather small; slightly swollen ventrolaterally; apex conoidal and directed medially; apex spinulose, the spinules minute and in short arcuate rows; palp a skewed peg bearing one apical and four subapical sensilla; galea digitiform, bearing two apical sensilla. Labium with anterior and lateral surfaces spinulose, the spinules minute and in short transverse rows; palp a low knob, with five sensilla; opening of sericteries wide and salient with two projections. Hypopharynx densely spinulose, the spinules minute and in numerous subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: several larvae from North Dakota.)

Formica cinerea Mayr

Gantes, 1949:—"*Larve âgée* d, ♀ (5e stade):—Elle est d'un blanc laiteux et mesure 6 mm.; le corps est cylindrique, légèrement arqué à la hauteur du premier segment abdominal, de sorte que la tête est repliée sur le ventre; le dos est convexe, la face ventrale concave. Le bout de l'abdomen est légèrement rétréci et arrondi; l'anus est subterminal et au fond d'un entonnoir. La tête est fine et nettement plus étroite que le prothorax. Le corps comprend onze segments séparés par de profondes constrictions: il y a trois segments thoraciques et huit abdominaux. Le corps est couvert de poils, pas très serrés, raides, se bifurquant en deux branches fines: ils mesurent 0 mm. 091; les branches secondaires peuvent se diviser et on a ainsi une fourche à trois branches. Il y a également des poils simples de la même longueur. Il y a dix paires de stigmates. La tête, plus étroite que le corps, 0 mm. 5, est en forme de poire; elle est plus large dans la partie postérieure, de

beaucoup la plus importante en étendue, que dans la partie antérieure qui comprend les pièces buccales. Elle est légèrement plus haute, 0 mm. 59, que large, 0 mm. 50. La partie postérieure est creusée d'une dépression peu profonde en son milieu qui descend jusqu'au labre. Elle est couverte de poils: trente pour chaque moitié (droite ou gauche), identiques à ceux du corps. Les antennes, à la partie la plus large, forment un mamelon à peine marqué, très large, et qui porte trois sensilles à soie. Les pièces buccales sont bien différenciées. Elles comprennent: le labre ou lèvre supérieure; les mandibules, à cuticle rigide; les maxilles, portant deux palpes sensoriels chacune; le labium ou lèvre inférieure, portant deux palpes sensoreils et où aboutit l'orifice des glandes salivaires. Le labre s'avance au-dessus des mandibules. Il comprend deux lobes égaux, séparés par une échancrure profonde qui laisse voir la pointe des mandibules. Vers le bord antérieur, ventralement, et sur chaque lobe, on a un groupe de cinq sensilles à soies. Dorsalement, deux minuscules poils se trouvent sur le bord antérieur. Toute la face interne est de plus tapissée de petites soies disposées en rangées transversales. Les maxilles, de part et d'autre du labre,sont proéminentes et portent deux palpes. Le palpe distal en forme de cône, haut et mince, mesure 0 mm. 06 de long et se termine par deux sensilles à soies courtes et arrondies. Le palpe proximal est plus court et plus massif, 0 mm. 03; il porte à son extrémité un groupe de trois sensilles et sur les côtés, diamétralement opposées, deux sensilles sans soies, six poils, dont deux minuscules entre les palpes, sont clairsemés sur les maxilles. Les mandibules sont des pyramides de 0 mm. 17 de haut. Elles ont une base très large et se terminent par une pointe fine, plus foncée. La partie externe est convexe et présente trois bosses. La partie interne est concave jusqu'à la base de la pointe, puis elle est convexe et sur cette dernière partie se trouve la zone masticatrice: des dents émoussées la garnissent; elles forment de rangées qui vont en s'atténuant vers la base. Les mandibules s'insèrent profondément dans la tête par toute leur base; à la hauteur de l'insertion, on voit des lames chitineuses striées, qui vont se rejoindre dans le fond de la bouche pour former l'épipharynx. Le labium, très proéminent, apparaît tout entier sous le labre. Il porte des palpes qui sont de chaque côté de l'orifice salivaire. Ces palpes forment chacun un mamelon garni de cinq sensilles à soie. Autour de chaque palpe on trouve quatre minuscules poils. Plus à l'intérieur, le labium se continue par l'hypopharynx, qui est tapissé de petits poils formant des rangées transversales.

"b) *Larve au premier stade:* Elle mesure 1 mm., est translucide, et l'on voit par transparence les ganglions nerveux, le tube digestif et même les glandes labiales sur certaines larves. Seuls les segments thoraciques sont bien séparés; ils sont plus étroits que la tête d'un côté et l'abdomen de l'autre; ce dernier est légèrement renflé et se trouve convexe sur tout son pourtour. Le corps est légèrement arqué. On compte 11 ganglions nerveux en ne tenant pas compte des ganglions cérébroïdes et sous-oesophagiens, et 10 paires de stigmates (larve holopneustique). La tête et le thorax sont couverts par quelques poils simples; le reste du corps est nu. On retrouve sur la tête les pièces buccales, mais moins accentuées que chez la larve âgée: les palpes sont

de légères saillies translucides. Les mandibules sont de petits triangles de 0 mm. 069 de long, presque transparents. Les maxilles sont rejetées latéralement" (pp. 74–76). Pl. I shows mature and newly hatched larvae in side view, head in anterior view, hairs, mandible, antenna, galea and palps. Growth data are given on p. 86.

Krausse, 1929, pp. 102–104:—Life cycle, egg 21 days (April 10–May 1), larva 14 days (May 1–15), pupa 26 days (May 15–June 10).

Formica difficilis Emery

Apparently similar to *altipetens*. (Material studied: damaged integuments of the anterior halves of seven larvae from New York.)

Formica exsecta Nylander

This species and its subspecies *pressilabris* Nylander are listed as hosts of the chrysomelid larva, *Clytra quadripunctata* by Skwarra (1927, p. 84); see under *F. rufa*.

Formica exsectoides Forel

Haviland, 1947, p. 413:—In artificial nests with the temperature held at 70° F., the life cycle was: egg 10–27 days, larva 21–53 days, pupa 25–30 days; averages, 19.4, 37.1 and 26.25 days respectively. At temperatures varying from 48° F. to 94° F. the life cycle was: egg 11–54 days, larva 11–53 days, pupa 22–35 days; averages, 21, 18.2 and 27.3 days respectively. The larvae are described as curved, legless and white.

Peirson, 1923, Pl. VI*E:* larva in side view.

Formica fusca Linnaeus

Similar to *altipetens* except for the following details: Body hairs about 40 per cent more numerous and somewhat longer (0.05–0.11 mm.). Cranium transversely subelliptical; breadth 1.4 X the length. Labial palp a short peg bearing five sensilla. (Material studies: several larvae from North Dakota.)

Young larva:—Length 2 mm. Abdomen stouter and shorter than in the mature larva; head relatively larger. Thirteen differentiated somites. Body hairs shorter (0.006–0.054 mm.); less abundant on the thorax and on abdominal somites I–III; about half as numerous on the fourth somite and very few on somites V–X. Integument of abdominal somites VIII–X spinulose, the spinules minute and in short transverse rows. Mandibles narrowed at the base; apical tooth sharp-pointed and directed medially. Maxillary palp and galea shorter and stouter. Labial palp a very low frustum bearing five sensilla; opening of sericteries represented by two low conoids. An older larva (length 3.8 mm.) is similar to the mature larva.

A colony of *F. fusca* collected by W. E. LaBerge near Park River, North Dakota, June 30, 1950, includes six semipupae each of which contains a large maggot. The semipupae are enclosed in cocoons and the meco nium has been voided. Mr. Willis W. Wirth has examined one of the maggots and has informed us that it is a phorid, but that further identification is impossible.

De Geer, 1778, Pl. XLII, fig. 13:—A larva in side view, probably *F. fusca.*

Donisthorpe, 1927*b*, p. 51:—The histerid beetle *Hetaerius ferrugineus* 01. feeds on the larvae of this ant.

Eidmann, 1929:—Semidiagrammatic drawing of all the larvae of an incipient colony on nine different days between February 22 and March 30 (Fig. 2 on p. 103). Cannibalism is discussed (p. 108) and two small larvae are shown feeding on a larger larva (Fig. 3 on p. 107). Life cycle (pp. 107–108): egg 28 days, larva (until start of spinning) 17 days, larva (start of spinning until pupation) 18 days, pupa 27 days.

Eidmann, 1943, pp. 243–244:—This ant hibernates without larvae.

Fielde, 1905, p. 375:—Photograph showing semipupae (cited as *F. subsericea*). (Repeated by Wheeler, 1910, Fig. 49 on p. 84 and by Emery, 1915, Fig. 3.)

Gösswald (1934/5, p. 133):—"*Atemeles* lebt als Larve im *Formica*-Nest und frisst hier die Brut ihrer Wirte."

Formica fusca japonica Motschoulsky

Clausen (1941, p. 57) has listed this ant as a host of *Eucharis scutellaris* Gahan in Chosen; presumably the eucharid larvae are parasitoid on the ant larvae.

Formica gagates Latreille

Skwarra (1927, p. 84) listed this ant as a host of *Clytra quadripunctata:* see under *F. rufa.*

Formica neoclara Emery

(Pl. IV, figs. 6 and 7)

Very similar to *altipetens* but differing in the following details: body and head hairs somewhat longer; anterior surface of labrum with four hairs and eight sensilla on each lobe. (Material studied: numerous larvae from North Dakota.)

Young larvae (1.9 mm. long) with nine sharply differentiated somites which are hairy; the rest naked. Antennae flat and not mounted on an elevation. Mandibles narrowed slightly at the base. Maxillae with the apex paraboloidal; palp a low elevation bearing five sensilla; galea a low subcone, with two apical sensilla.

Formica neorufibarbis algida Wheeler

Worker larva similar to *altipetens.* (Material studied: 17 larvae from Michigan.) A queen larva of this subspecies from a New Hampshire colony is very similar to the worker larva except for larger body size, relatively smaller head and sparser body hairs which are simple spikes about 0.054 mm. long.

Formica obscuripes Forel

Similar to *altipetens* but differing in the following details: Body hairs slightly longer. Anterior surface of labrum with two hairs and about eight sensilla on each lobe; posterior surface with about six

sensilla on each lobe. (Material studied: numerous larvae from North Dakota.)

Weber (1935, p. 190) has given the life cycle as: egg 23–53 days, larva 7–33 days, worker pupa 31–93 days.

Formica rufa Linnaeus

Adlerz (1886, p. 56):—Internal anatomy.

Bedel, 1895:—*Eucharis bedeli* Cameron "attaque les cocons de *Formica rufa* L." in Bohemia. Presumably the eucharid larva is parasitoid on the ant larva. Rushka (1924, p. 88) suspected, however, that the hymenopteron was *E. ascendens* Fab. Wasmann (1894, p. 168) refers to *Chalcura* sp. bred from cocoons of this ant in "Prag (Polak)."

De Geer, 1778, Pl. XLI, Figs. 16 and 17:—Larva in side view.

Dewitz, 1878, pp. 78–79:—"Die erwachsenen Arbeiterlarven. . . . besitzen eine Länge von 0.006 m.; ihr Körper besteht aus 13 Ringen ausser dem Kopfe und spitzt sich nach vorn etwas zu, während das hinter halbkuglig abgerundete Ende fast noch denselben Durchmesser zeigt, wie der mittlere, dickste Theil. Kopf und Brust krümmen sich der Bauchseite zu. Der Kopf ist . . . klein, doch nimmt man deutlich die Kiefer und Unterlippe mit ihren Tastern wahr. Die Länge der ersten Körpersegmente ist auf der Rückenseite eine viel beträchtlichere als auf der Bauchseite, und so wird die Krümmung des vorderen Abschnittes hervorgebracht. Die Stigmen sind kreisrund und liegen, der Rückenseite genähert an dem vorderen Theile eines jeden Segmentes; das erste Stigma gehört, wie man sich aufs deutlichste überzeugen kann, dem zweiten Brustringe an. Wenngleich bei der späteren Entwickelung die Theile des Brustkastens sich sehr verändern, und die Stigmen sich hierbei verschieben, so dass das erste auf der Grenze des ersten und zweiten Brustringes zu liegen kommt, und man bei dem erwachsenen Thier nicht mehr unterscheiden kann, welchem abschnitte der Brust es angehört, so lehrt uns doch das Larvenstadium, dass das erste Segment stigmenfrei ist.—Die noch nicht erwachsenen Larven besitzen dieselbe Körpergestalt, doch in den jüngsten Stadien einen im Verhältnis viel stärkeren Kopf."

Donisthorpe, 1915, Pl. III = 1927*a*, Pl. III:—An excellent photograph of a larva in side view.

Donisthorpe, 1927*b*, p. 55:—The histerid beetle *Myrmetes piceus* Pk. feeds on the ant larvae.

Eidmann, 1943, pp. 244–250:—This species hibernates without larvae.

Pérez, 1902:—His description of the internal anatomy of this larva was followed by Wheeler (1910, pp. 75–76 and Fig. 44 on p. 78).

Ratzeburg, 1832:—"Die Larve . . . ist milchweiss, überall gleichmässig schwach durchscheinend und fein und ziemlich dicht behaart. Sie besteht: 1) aus zwölf fast gleich gebildeten, häutigen, sehr weichen, ziemlich breiten Ringen, deren jeder aus zwei Theilen besteht, einem oberen gewölbteren, und einem unteren flacheren. Die Einschnitte, wo beide rechts und links sich vereinigen, liegen auf jeder Seite der Bauchseite, so dass der obere Theil grösser als der untere ist. Der letzte Ring ist sehr klein, stumpf kegelförmig und hat am Ende eine Falte, hinter welcher der After liegt. Die Luftlöcher (*stigmata*) liegen

am Obertheil jedes Ringes, zur Seite desselben. Es findet sich an den Ringen weder von Füssen noch von Wülsten eine Spur; 2) aus einem kleinen, fast kugelrunden dunkler gefärbten und härteren Theil, welcher an den ersten Leibesring sich anschliesst und Kopftheil genannt werden kann, aber keinesweges Kopf heissen darf, wofür er bisher von den Schriftstellern gehalten wurde. Er sieht einem, freilich nur sehr kleinen, Kopfe allerdings sehr ähnlich, denn er ist völlig unabhängig von der zwölf Leibesringen, bewegt sich ganz frei und kann sich sogar in den ersten Ring wie in eine Kappe zurückziehen; man sieht dann an der Unterhälfte des letztern eine halbmondförmige Falte entstehen, welche dem Ausschnitt an der Unterseite des Bienen- und Ameisenkopfes ähnelt, in den sich die innern Mundtheile befestigen. Auf der Oberseite dieses Kopftheils bemerkt man nun weder Augen . . . noch Antennen, was diejenige, die ihn für einen wahren Kopf ansprechen, doch schon hätte bedenklich machen sollen; man bemerkt nur jederseits eine etwas gewölbte, in der Mitte mit einem kleinen Eindruck versehene fast hornige Hälfte (Hülle für die künftig sich bildenden Oberkiefer), und zwischen beiden, in der Mittellinie, einen erhabenen, etwas glänzenden, nach vorn sich erweiternden Streif. Am vordersten Ende trägt eine jede hornige Hälfte ein kleines dreieckiges, spitziges, dunkelbraunes, glänzendes . festes Hornstückchen, die eigentlichen Oberkiefer, *mandibulae* der Larve, welche man das lebende Thier auch bewegen sehen kann. Unterhalb dieser liegen die innern Mundtheile, welche so zart, weiss und gallertartig sind, dass man bei der angestrengtesten Beobachtung mit der Lupe doch irren kann. Da ich sie einigemale auf verschiedene Weise gebildet gesehen zu haben glaube, so vermuthe ich, dass sie schon in diesem ersten Stadium einer Verwandlung unterliegen, dass sie sich in einer frühen Zeit, man möchte sagen auf einer Stufe befinden, auf der die Bienenlarven, in Hinsicht der Mundtheile sehr lange verweilen. Während nämlich bei der ganz jungen Ameisenlarve alle innern Mundtheile in einen fast kegelförmigen, überall gleichmässig gallertartigen Theil verschmolzen waren, der nur an der Seite nach vorn eine schwache Ausrandung zeigte, so sah ich später diesen Theil immer nur getrennt in zwei deutliche, durch Absätze und Bewegungen geschiedene Theile. Der Theil vor den Mandibeln erschien breit, abgerundet-viereckig, vorn mit einer Ausrandung und zu jeder Seite derselben mit zwei borstenartigen, braunen Spitzen, deren beide innere aber so nahe an dem mittelsten Theil standen, dass man sie auch für diesem zugehörig halten konnte. Der eben genannte mittelste Theil steht wieder unterhalb des vorigen, ragt aber etwas über ihn hinaus. Er ist vorn gerade abgestutzt und scheint walzenförmig zu seyn. Er ist beweglich und das lebende Thier kann ihn zurückziehen und wieder etwas vorstrecken. In einer Mittelstufe zwischen dieser und der nächsten sah ich deutlich den durch die weisse, gallertartige Masse braun durchschimmernden Oesophagus in diesen Theil münden. Auf der Unterseite des Kopftheils sieht man die beiden zuletzt genannten Theile einen für sich bestehenden, etwas gewölbten Theil bilden" (pp. 149–153). The semipupa was described on p. 156. Fig. 1, larva in side view; Fig. 2, larva in ventral view; Figs. 3 and 4, head in anterior view; Fig. 5, head in posterior view; Fig. 6, larva in dorsal view; Fig. 7, semipupa in side view; Fig. 8, anterior end of semipupa in side view.

Skwarra (1927) concluded concerning the larvae of the chrysomelid beetle *Clytra quadripunctata* L. "dass ihre Nahrung in erster Linie in der Brut der Ameisen, besonders Larven und Puppen, besteht. Sie sind also nicht harmlose Mitbewohner der Ameisennester, die sich vom Abfall ernähren, sonder gefährliche Bruträuber" (p. 95). *F. rufa* is listed as a host (p. 83).

Formica rufa pratensis Retzius

Gösswald (1932, p. 38 and 1934/5, p. 142) recorded *Eucharis ascendens* F. reared from queen pupae in Germany; presumably the eucharid larvae had been parasitoid on the ant larvae.

Skwarra (1927, p. 84) listed this subspecies as a host of *Clytra quadripunctata:* see under *F. rufa* above.

Formica ulkei Emery

Similar to *altipetens* but differing in the following details: Body hairs sparse. Anterior surface of labrum with four hairs and about six sensilla on each lobe. Maxillary palp a short forked peg with an apical sensillum on each fork and with three lateral sensilla. (Material studied: numerous larvae from North Dakota.)

The queen larva differs from that of the worker in the much larger body, the relatively smaller head, and in the hairs which are few, slender, whip-like and about 0.13 mm. long.

Park, 1929, p. 205:—The carabid beetle, *Tachyura incurva* (Say) has "been seen to devour crushed larvae and pupae." In 1935 (p. 223) he reported it as feeding on the brood in laboratory nests.

Formica uralensis Ruzsky

Skwarra (1927, p. 84) listed this species as a host of *Clytra quadripunctata:* see under *F. rufa* above.

Subgenus **Raptiformica** Forel

Cranium transversely subelliptical in anterior view. Mandibles with the mesal border jagged near the base of the apical tooth.

Formica (Raptiformica) bradleyi Wheeler

(Pl. IV, figs. 11–14)

Body stout; thorax and abdominal somite I curved ventrally, rest of abdomen straight; diameter greatest at the fourth abdominal somite, diminishing gradually toward either end; posterior end narrowly rounded; lateral longitudinal welts feebly developed; prothorax with a pair of lateral swellings. Anus terminal with a prominent posterior lip. Leg, wing and gonopod vestiges present. Thirteen differentiated somites. Body hairs short (0.05–0.09 mm.), moderately abundant and uniformly distributed, mostly with tips bifid, rarely trifid or simple; without alveolus or articular membrane. Integument spinulose, the spinules minute and in short transverse rows. Cranium transversely subelliptical in anterior view, a third broader than long. Head hairs

moderately numerous, short (0.045–0.063 mm.); with the tips bifid or simple; alveolus and articular membrane present. Antennae mounted on low convexities; drumlin-shaped; three sensilla each. Labrum bilobed due to a wide shallow impression of the ventral border; about twice as broad (at base) as long; slightly narrowed ventrally; ventral corners rounded; anterior surface of each lobe with a ventrolateral swelling and with a dozen sensilla and/or minute hairs; ventral border spinulose; posterior surface spinulose, the spinules minute and in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; posterior surface of each lobe with six scattered sensilla. Mandibles rather small and moderately sclerotized; breadth (at base) nearly equal to length; roughly quadrangular in anterior view; mesal border convex; lateral border obtusely angulate near the middle; wedge-shaped, with the edge medial; apical tooth distinct, slender, smooth, tapering, round-pointed and slightly curved medially; mesal border jagged near the base of the apical tooth; anterior and posterior surfaces roughened with numerous sublongitudinal ridges. Maxillae swollen ventrolaterally; apex short-conoidal and directed medially; apex spinulose, the spinules minute and in short rows; palp a stout skewed peg bearing five sensilla; galea digitiform, bearing two apical sensilla. Labium with anterior and lateral surfaces spinulose, the spinules minute and arranged in short arcuate subtransverse rows; palp a low knob bearing five sensilla; opening of sericteries wide and salient with two projections. Hypopharynx densely spinulose, the spinules minute and in numerous subtransverse rows, the rows grouped in two subtriangles which have their bases near the middle. (Material studied: numerous larvae from North Dakota.)

Formica (Raptiformica) sanguinea Latreille

Donisthorpe, 1927*b*:—The staphylinid larva *Lomechusa strumosa* F. devours the brood of this ant (p. 22). Another staphylinid (*Dinarda pygmaea* Wasm.) was seen to devour a larva (p. 28). The histerid beetle *Hetaerius ferrugineus* 01. feeds upon the larvae and pupae (p. 51). Referring to the staphylinid genus *Lamprinus*, "both the adult beetle and their larvae devour the ants' eggs, larvae, and pupae" (p. 72).

Gösswald, 1932, p. 38 and 1934/5, p. 142:—*Eucharis ascendens* F. was reared from queen pupae of this ant; presumably the eucharid larvae were parasitoid on the ant larvae.

Gösswald (1934/5, p. 127) and Skwarra (1927, p. 84) have listed this ant as a host of *Clytra quadripunctata:* see under *F. rufa.*

Wheeler, 1928a:—The larvae of *Lomechusa* "devour the brood and are also fed by regurgitation. . . . The ants seem to prefer the predatory larvae to their own, or perhaps regard them as unusually promising ant larvae. In consequence of this infatuation the Lomechusa larvae often destroy the greater part of the brood, so that in *sanguinea* colonies heavily infested with the parasites the queen larvae develop abnormally" (p. 207) into peudogynes (p. 208). (See also p. 262.) (=Wheeler, 1926, pp. 250–252 and 315–316.) (Brief reference by Gösswald, 1934/5, p. 126.)

Formica (Raptiformica) sanguinea subnuda Emery

Similar, in general, to ***bradleyi*** but with longer hairs on the anterior surface of the labrum, with the mandibles slightly more elongate and with the apical tooth slightly sharper. (Material studied: numerous larvae from North Dakota.)

Tribe **Gigantiopini** Ashmead

Wheeler (1922b, pp. 190–191) used larval (in addition to adult) characters to justify the removal of *Gigantiops* from "Forel's tribe Oecophyllini and to provide an independent tribe for its accommodation." "When we compare *Gigantiops* with *Oecophylla* we are struck at once by the great differences in the structure of the larva, pupa and adult and in habits. . . . The larva of *Gigantiops* is like that of *Camponotus*, but very different from that of *Oecophylla*, and the pupa is enclosed in a cocoon."

Genus **Gigantiops** Roger

Thorax forming a short thick neck, which is strongly arched ventrally; abdomen straight, swollen and subcylindrical. Body hairs abundant, rather short and of three types: (1) simple, slender and whip-like, (2) 2- to 4-branched, (3) moderately stout, slightly curved and denticulate. Cranium transversely subelliptical in anterior view; integument sparsely spinulose. Antennae minute. Head hairs numerous, long, denticulate and whip-like. Labrum with a median longitudinal furrow on the anterior surface. Mandibles heavily sclerotized. Maxillary palp finger-like. Labial palp a skewed peg.

Wheeler, 1922*b*: see above under the tribe.

Gigantiops destructor (Fabricius)

(Pl. IV, figs. 18–22)

Thorax forming a short thick neck, which is strongly arched ventrally; abdomen straight, swollen and subcylindrical. Posterior end rounded. Leg, wing and gonopod vestiges present. Seven or eight differentiated somites. Body furnished with a dense and uniform covering of rather short hairs or three types: (1) simple, slender, and whip-like, 0.21–0.49 mm. long; (2) 2- to 4-branched, 0.07–0.21 mm. long; and (3) moderately stout, slightly curved, denticulate, with long or short side branches, 0.14–0.23 mm. long. Body hairs without alveolus and articular membrane. Integument densely spinulose, the spinules minute and arranged in subtransverse rows. Cranium nearly 1.5 × as broad as long, genae bulging, occipital border nearly straight, dorsal corners broadly rounded; integument spinulose, spinules minute and in short transverse rows. Head hairs numerous, long (0.16–0.32 mm.), whip-like and denticulate; with alveolus and articular membrane. Antennae minute, each with three sensilla. Labrum twice as broad (at base) as long; strongly narrowed ventrally, conspicuously bilobed due to a deep median incision of the ventral border, which is continued onto the anterior surface as a median trench; anterior surface of each lobe with five or six short hairs and two or three sensilla;

five sensilla on (or near) the ventral border of each lobe; posterior surface spinulose, spinules minute to relatively long and in rows which radiate from the dorsolateral angles, the rows continuous near the base but broken distally; about a dozen sensilla scattered irregularly over the posterior surface of each lobe. Mandibles heavily sclerotized; subtriangular in anterior view; wedge-shaped, with the edge medial; apex forming a short, smooth, rather stout, round-pointed tooth which is curved medially; anterior and posterior surfaces roughened with numerous longitudinal ridges. Maxillae with the apex paraboloidal and roughened with numerous minute isolated spinules; palp finger-like, with two apical, two subapical and one lateral sensilla; galea finger-like, with two apical sensilla. Labium with the anterior and lateral surfaces spinulose, the spinules minute and in short transverse rows near the middle but longer and in arcuate rows laterally; palp a skewed peg bearing one apical, three subapical and one lateral sensilla; opening of sericteries wide and salient, with two projections. Hypopharynx spinulose, the spinules minute and arranged in subtransverse rows, the rows grouped in two subtriangles whose bases are near the middle. (Material studied: six damaged integuments from British Guiana.)

Wheeler, 1922*b*:—"As soon as I began to dig into their nest the workers leaped out and made off, holding their larvae in their mandibles" (p. 189). See also above under the tribe.